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July 29, 1921

Mr. Samuel S. Wyer,
Hartman Building,
Columbus, Ohio

Dear Sir:

I have your letter of the 26th and in reply would state that no Proceedings of the American Gas Institute were published after 1916 and that the first Proceedings issued by the American Gas Association begins with the year 1919.

It therefore appears that you have in your possession all the volumes of the Proceedings which have been issued.

Yours very truly,

Percy N. Na

Assistant Secretary-Manager

PHH:MAH

July 26, 1921

American Gas Association,
130 East 15th Street,
New York City.

Gentlemen:

In checking over my library, I have noted the Proceedings of the American Gas Institute, in my possession, stop with Volume 11 - 1916, Part 2, and the first Volume of the American Gas Association begins with year 1919.

I am wondering if I have missed any of the volumes of the American Gas Institute or whether the lapse for 1917 and 1918 is due to the inactivity during the world war period.

In case there are volumes following Volume 11 of the American Gas Institute, I will, of course, want to arrange to get them so as to have my set complete.

Yours truly,

SSW F

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130 West 15th Street,
New York City.

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Yours truly,

SSW F

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PROCEEDINGS

OF THE

American Gas Institute

ELEVENTH ANNUAL MEETING

OCTOBER 17, 18, 19, 20, 1916

CHICAGO, ILL.

Part II

PUBLISHED BY THE INSTITUTE
EDITED BY THE PUBLICATION COMMITTEE
1917

FOR CONTENTS SEE PART I.

PRESS OF
THE CHEMICAL PUBLISHING COMPANY
EASTON, PA.

ILLUMINATION SECTION.

Thursday, October 19, 2.30 P. M.

Mr. C. O. Bond, *Vice-President,* presiding.
Mr. C. W. Jordan, *Secretary.*

The Chairman: The section will come to order. You will recall, gentlemen, that 2 years ago we had a session of the Illuminating Section, but last year in the City of San Francisco there were no separate sessions held, so that this session, in a way, ties on with the work that was under way 2 years ago. As will be shown in the report of the Committee on Gas Lighting this afternoon, one of the subjects left for treatment was that of Gas Ignition. The Committee does not stand sponsor, of course, for the treatment given the subject this afternoon, but we were very much indebted to Mr. T. J. Litle, Jr., for having prepared a paper bringing up to date the subject of Gas Ignition. We will now hear the paper.

GAS IGNITION.

There is probably no one subject of more importance to the gas lighting industry than "Ignition." There have been a very large number of devices invented, some of them extremely ingenious to obviate the use of the match, but it can be safely said that the match is still the most used at the present time. There was a time, however, in the history of gas lighting when even the match was not available and the early gas lamps were lighted by the steel and tinder box method, for matches were not invented until 1827.

The match was such a great improvement over these earlier methods that it was considered perfection for a great many years and no thought was given to its replacement by some more convenient igniter. It was really not until after the advent of the incandescent mantle lamp and the electric light that any serious attempt was made to improve on the friction match igniter.

The gas ignition problem in connection with the gas engine

is very similar to that of the gas burner used for purposes of illumination, and while the problem might seem to be more difficult in the gas engine on account of the highly compressed charge of gas and air, it must be remembered that it is possible in the case of a gas engine to supply a very complete equipment representing a considerable investment, whereas this would not be generally feasible in the case of the gas lamp, and

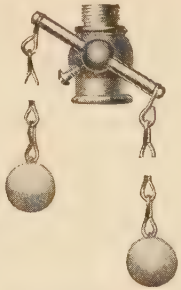


FIG. 1.—Earliest type of burner throttling by-pass.

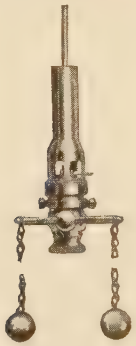


FIG. 2.—Pilot by-pass with pilot flame in center of mantle.

any device which costs as much (and in some cases several times as much as the burner itself) must of necessity have a limited sale and use. The great problem, therefore, to be solved is some inexpensive and reliable method of ignition.

In the case of the gas engine, the universally used jump spark system was adopted on account of its most satisfactory operation. First, it is the high tension jump spark which is extremely hot, assuring prompt ignition of mixtures of varying richness, as well as mixtures under very high compression.

The troubles incident to the use of the jump spark on gas engines in the earlier days were mostly due to faulty construction of the induction coils or small "step-up" transformers that were used, together with the high tension distribution system and the faulty construction of the spark plugs.

It must also be remembered that the ignition system on a gas engine would receive very much more attention and is better understood than a similar system applied to gas-burner ignition. Consequently, the electric system of ignition has not come into general favor in connection with gas burners.

The earliest type of auxiliary gas flame for ignition of incandescent gas lamps was probably the turned down by-pass. This device consisted of a small cock placed beneath the burner, which could be so adjusted as to reduce the flow of gas through the main burner so as to burn only a fraction of a foot per hour, the flame burning in a thin film on the surface gauze of the burner, using an upright mantle. About the same time that this device was marketed a pilot flame burning at the end of a small tube placed near the mantle was introduced. This was a decided improvement over the device just mentioned, in that it burned very much less gas. The pilot ignition has been improved from time to time principally by the protection of the metal tube by the use of lava or clay tips, and rather recently by the introduction of a semi-luminous pilot flame, in which a small amount of air is mixed with the gas before burning.

In conjunction with the use of pilot ignition, various automatic devices have been used to control the size of the flame when the lamp is burning and when extinguished and other devices have been marketed to insure the continuous burning of the pilot on adverse gas conditions. In this case miniature filters are introduced into the pilot line and to remove the tar or oily matter held in suspension in the gas.

The most recent development of ignition is strangely enough in the pilot class, and is an incandescent pilot. This will be described in detail under a separate heading. While the pilot is the oldest form of self-contained gas-burner igniter, it is

still the most used and has always been the most popular method of ignition, due probably to the fact of its great simplicity and inexpensive construction.

Electric Ignition.

Electric ignition followed in somewhat parallel lines to that of the internal combustion motor. The first electric ignition of any importance was used in connection with the open flame gas burner of the make and brake type known as the "wiping

FIG. 3.—By-pass fitted with clay tip, producing a semi-luminous flame; also containing filtering material to extract tar or oily substance from gas. This filter is located in the horizontal portion extending out from body of by-pass.

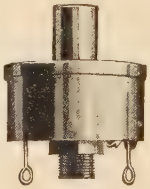


FIG. 4.—Electrically operated cock or magnet valve for distant control of gas burners.

spark device." The current was supplied from primary cells with a self-induction coil composed of a bundle of soft iron wire used as a core surrounded by a few layers of heavy insulated copper wire. This coil introduced in the circuit produces a powerful voltage surge after the contacts have been broken, causing an arc to follow for some distance. There was a time when practically all of the new residences in some of the Eastern cities were equipped with this system of ignition.

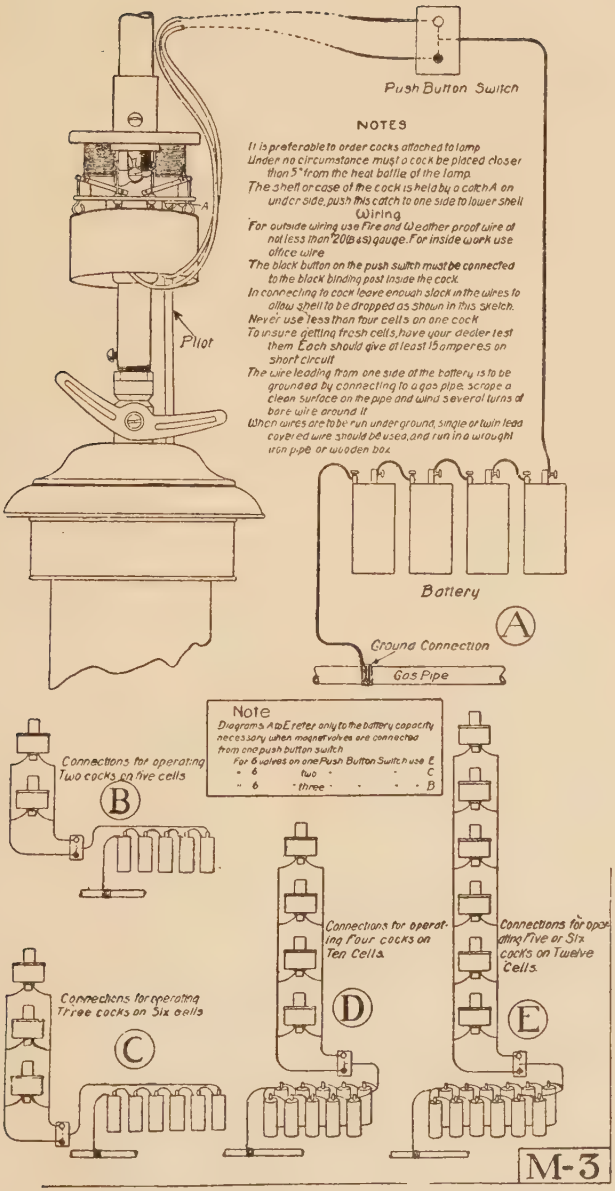

Push Button Switch
NOTES
It is preferable to order cocks attached to lamp
Under no circumstance must a cock be placed closer than 5" from the heat baffle of the lamp
The shell or case of the cock is held by a catch A on under side, push this catch to one side to lower shell
Wiring
For outside wiring use Fire and Weather proof wire of not less than No 20 (B & S) gauge. For inside work use office wire
The black button on the push switch must be connected to the black binding post inside the cock
In connecting to cock leave enough slack in the wires to allow shell to be dropped as shown in this sketch
Never use less than four cells on one cock
To insure getting fresh cells, have your dealer test them Each should give at least 15 amperes on short circuit
The wire leading from one side of the battery is to be grounded by connecting to a gas pipe, scrape a clean surface on the pipe and wind several turns of bare wire around it
When wires are to be run underground, single or twin lead covered wire should be used, and run in a wrought iron pipe or wooden box
A
Pilot
Battery
A
Ground Connection
Gas Pipe
Note
Diagrams A to E refer only to the battery capacity necessary when magnet valves are connected from one push button switch
For 6 valves on one Push Button Switch use E
" 6 " two " " C
" 6 " three " " " B
Connections for operating Two cocks on five cells
B
Connections for operating Three cocks on Six cells
C
Connections for operating Four cocks on Ten Cells
D
Connections for operating Five or Six cocks on Twelve Cells
E
M-3

FIG. 5.—Diagram of circuits of electric cock and battery connections.

The automatic electric igniter made it possible to control a gas burner from a distant point by means of a double push button. In this case electric magnets were used to operate the gas valve; the make and break spark automatically operated near the burner ignited the gas.

It is commonly known that when a person walks across the floor on a dry day and drags his feet on the carpet, his body will be charged with electricity and just before he touches the gas fixture or other metallic body a spark will jump from the finger to the metal. Advantage was taken of this phenomenon by the construction of the jump spark electric igniters. The earliest types were operated by static electric generators, but as these were dependent upon climatic conditions they were not used; the current from an induction coil, however, proved quite satisfactory.

Jump Spark System.

In this system an induction coil of the "step-up" type is used, an interrupted direct current in the primary circuit induces a high tension secondary current sufficiently high in voltage to cause a spark to jump through the air between the secondary terminals if they were not spaced too far apart. It is the usual practice to make the spark gap on a gas burner about 1/32 inch. It is possible to place a large number of these igniters in series and thus ignite a large number of burners. This has been a very popular method of ignition in churches, theatres and other large buildings.

There has recently been an interesting development in this system, whereby it may be used in private residences. In this case an individual coil capable of furnishing current of sufficient voltage to operate from one to five burners is placed directly on the fixture. This obviates the necessity for using great care in insulating the secondary circuit from the point of control to the burner, as in this case the coil is adjacent to the burners.

Distant control is accomplished by using an electrically operated cock at the burner.

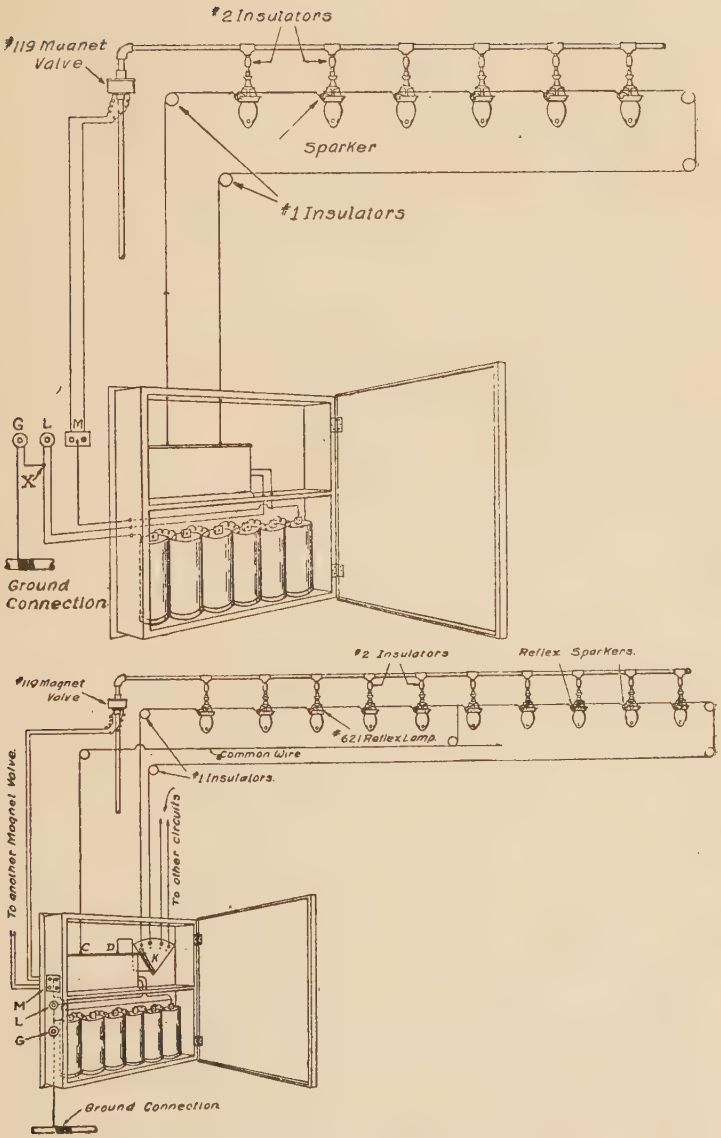


FIG. 6.—Diagram of the jump spark electric system of ignition.

Numerous pilot lighters have been designed which will flash with a long flame to insure ignition when the gas is turned on, the flash being automatically cut off after ignition. Lamp post lighters have been designed to cause a series of flames to

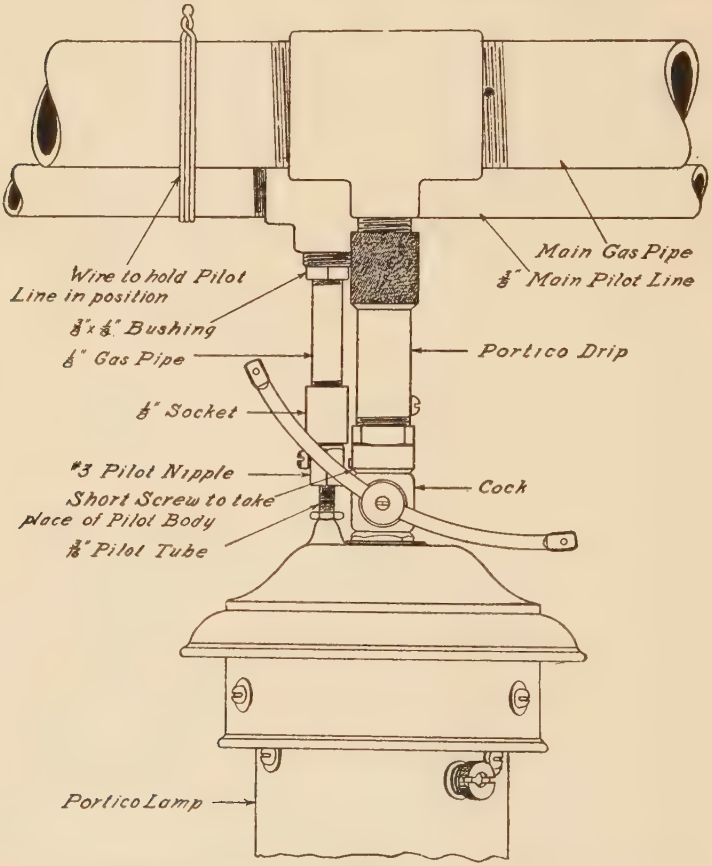


FIG. 7.—Shows method of making pipe connections for independent pilot systems where a separate gas line feeds a number of pilots and another gas line feeds the lamps to be ignited.

pass from a lighting port through which a torch may be introduced to the main burner. This is known as the climbing pilot lighter.

Hot Filament Electric Ignition.

Various attempts have been made to utilize the very simple expedient of using a platinum or platinum alloy filament heated to incandescence by an electric current. In some cases the catalytic action of the gas upon the platinum makes it unnecessary to actually bring the wire up to a bright incandescence. On the other hand, there are some cases, such as on natural gas, in which this system will not operate satisfactorily. Fix-

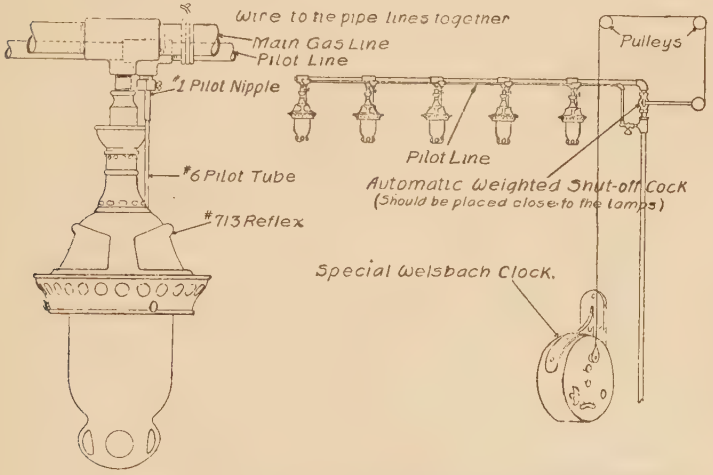


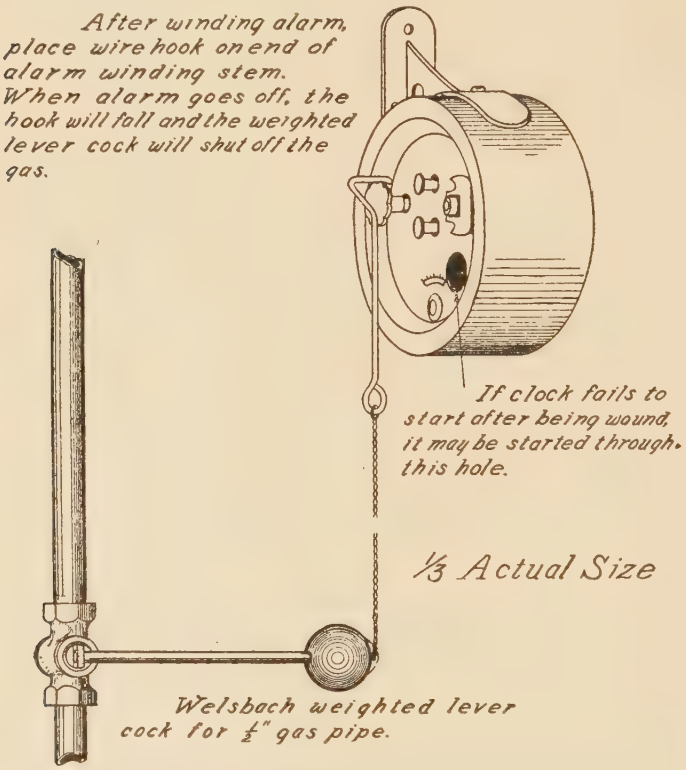
FIG. 8.—Diagrams indicating method of installing a cock to automatically extinguish lamps at some predetermined time.

tures were produced in which a single dry cell enclosed in the fixture furnishes sufficient current for the ignition of from one to four burners.

Catalytic Lighters.

It is a well known fact that the temperature of platinum black is increased in the presence of a stream of hydrogen. Taking advantage of this phenomenon, gas lighters were designed in which the platinum black was used as a heater in contact with a number of small platinum or platinum rodium filaments. When the gas contacts the heater it is increased in temperature, the heat traveling to the fine wires which in turn

are raised by catalytic action to a very much higher temperature than the heater, and the ignition is produced by these wires. There have been a large number of catalytic igniters produced, the important types as follows:


After winding alarm, place wire hook on end of alarm winding stem. When alarm goes off, the hook will fall and the weighted lever cock will shut off the gas.
If clock fails to start after being wound, it may be started through this hole.
⅓ Actual Size
Welsbach weighted lever cock for ½" gas pipe.

Installation of Clock-Controlled weighted lever cock for shutting off gas automatically

FIG. 9.—Detailed diagram of shut-off clock attachment.

Separate or portable lighter, which may be carried in the pocket or placed at the end of a long rod.

Others were attached directly to the burners, some being placed directly over the top of the chimney, and others suspended over the chimney when the lamp is not burning and

automatically removed by thermostatic means from the path of the products after the gas has been ignited. Sub-flame lighter in which a stream of gas is lighted by the catalytic lighter and which is in turn extinguished after the main burner has been lighted from this sub-flame; and finally the platinum salts may be applied directly to the surface of the incandescent mantle. The heater is sometimes made up in a separate pellet form and cemented to the surface of the mantle and radiating streaks composed of platinum salts painted on the mantle surface. These self-lighting mantles and all similar self-lighting

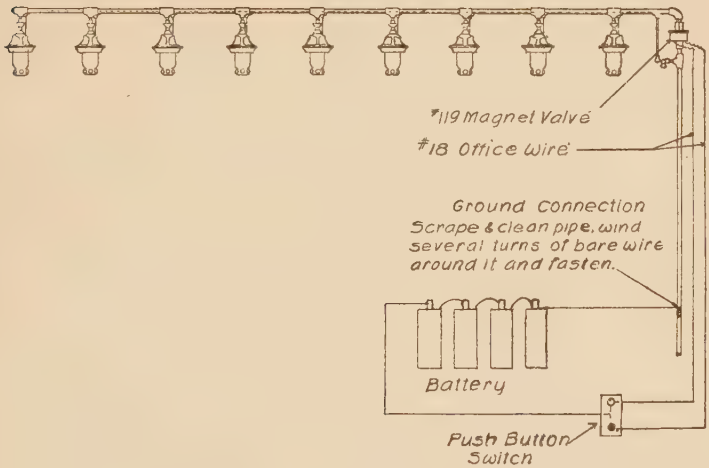


FIG. 10.—Indicates method used for controling a number of burners electrically from a distant point by means of the electric cock, the independent pilot system being used for ignition.

devices are not reliable in their action, as they depend too much upon the quality of the gas, the condition of the atmosphere and they are deteriorated in the presence of heat as well as by the products of combustion.

A modification of this type of lighter was one in which the catalytic lighting agent was contained in a vessel in which there was a wick saturated in wood alcohol. The operation of withdrawing the lighter from the wood alcohol vapor ignited it, which flame in turn was used to ignite the gas

burner. In this case the catalytic action is made independent of the gas quality which is responsible for the intermittent operation of lighters of this type.

Pyrophoric.

A very interesting igniter is one using what is known as pyrophoric alloy, invented by Dr. Carl Auer Von Welsbach. This alloy is an electric furnace product, composed of iron

FIG. 11.—Fixture containing dry cell and electric igniters over each burner. Gas is turned on and electric contact is made when lighting chain is pulled.

and cerium and has the property of emitting bright hot sparks when abraded or scratched. Ignition is obtained very much as in the old method by the use of flint and steel, except in the case of this alloy, it is not necessary to exert as much pressure, as the particles are torn from the main body and brought to incandescence by the expenditure of comparably little energy. Pyrophoric lighters are divided into two classes. First, the

low speed of the heavy pressure type, and second, the high speed light pressure type. They are divided mechanically into two classes, one using a reciprocating abrader in the shape of a flat file and the other a rotary abrader in the shape of a

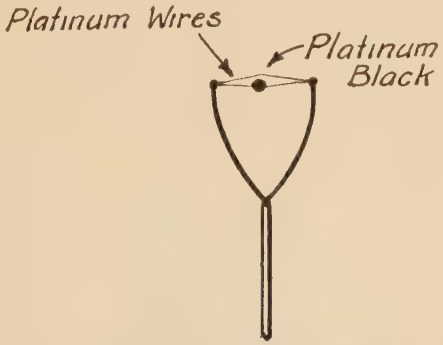


FIG. 12.—Typical sketch of catalytic lighter, in which platinum black pellet is fastened to fine platinum wires.

FIG. 13.—Self-lighting mantle.

circular file. The high speed abrader seems to be the most reliable form; first, because there is less energy required to operate it and also because the material does not wear away as rapidly. Various forms of igniters have been devised to

be attached directly to the burners, operated by a pendant pull or a key, some merely used to produce a spark after the gas has been turned on at the fixture key and others turning on the gas and igniting it with the same operation. This type of

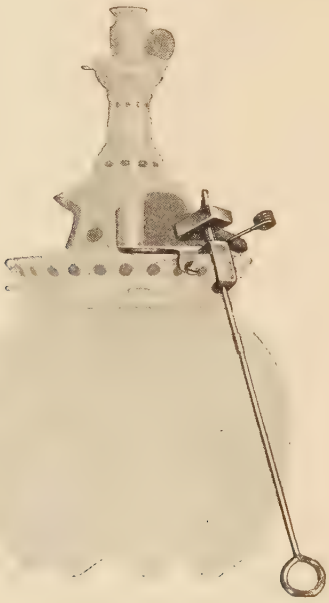


FIG. 14.—Pyrophoric igniter. Gas is first turned on at the fixture cock and the handle of lighter is elevated and rotated, producing sparks in the path of the gas flow.

igniter can be said to be still in the experimental stage and there are prospects of the production of a good igniter along these lines.

Chemical and Pyrotechnic Lighters.

There have been in the past several types of lighters classified under the above heading, but none of these have more than a historical value, as they never were placed in practical use.

There have been several interesting igniters developed, using matches or paper strips, containing phosphorus and sulphur

pellets, which may be fed automatically close to the burner and ignited by friction. These lighters have never been put in general use.

Glower.

The most recent type of igniter is strangely enough in the pilot class. It has been before stated that the pilot igniter has been the most popular on account of its simplicity and cheapness.

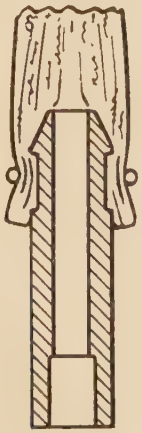


FIG. 15.—Cross section of glower pilot.

A great deal of research work has been done on pilot flames to make them withstand a high draft, as it is extremely difficult, particularly in some types of gas burners, to protect them from air currents in the room. Various types of protecting boxes and cages have been constructed, and while they protect the pilot to some extent they cannot very well be adapted to the small residential burner. Experiments were conducted with an idea of using a catalytic material to re-light the pilot flame in case it should be accidentally extinguished, but this did not prove to be satisfactory. In the course of these experiments a pilot was designed in which a bundle of rare earth filaments were placed around the mouth of the pilot tip completely covering the flame. It was found that a surprisingly

small amount of gas was required to bring the entire bundle of several thousand filaments to a bright incandescence, a combustion seeming to take place throughout the mass, in this case very much as it does in certain types of surface combustion apparatus, so this pilot may be said to be a surface combustion pilot.

The most remarkable feature in connection with this new development is the fact that the glowing mass cannot be blown out by the strong draughts which ordinarily extinguish pilot flames. In a stiff breeze the mass will be cooled down below the incandescent point on the windward side, but be found to be glowing brightly on the leeward side. After the draught has subsided, the entire mass quickly rekindles. There is probably a catalytic action present in this rekindling.

Another very important feature is that this type of pilot consumes much less gas than does the open-flame pilot, and another striking feature is that the glowing mass furnishes sufficient illumination at night to enable a person not only to locate the lamp in the dark, but it gives sufficient light to distinguish articles of furniture or to easily recognize a person several feet distant. For instance, if a newspaper is held about 10 inches from the device it can easily be read. The importance of this device as a night light and the fact that it consumes so little gas probably marks an epoch in gas illumination.

Mr. T. J. Litle, Jr. (Gloucester, N. J.): We have arranged a demonstration of this last mentioned pilot, the glower, on the board, on the mantle-piece, where we have four pilots burning; the two end pilots are the glowers that I have just described. One is a blue-flame pilot, I doubt whether you can see it, except those in the front row. In this case we have the ordinary open-flame pilot. The two center pilots are turned very much higher than they would be in practice, simply so that you can see them, the blue-flame pilot is about ⅜ inch high and the other is about ½ inch high. I explain that because I doubt whether those in the back row can see them.

These are the pilots mentioned in the last part of the paper,

the glower, and consist merely of a metal tip with a bundle of filaments surrounding the tip; they are manufactured and sent out in rag form; in other words, the webbing which is used in this case is similar to that used in the regular mantle except that the impregnation is different; we have found that the ordinary impregnation used in the mantle webbing was not strong enough for this purpose. On the bundle of saturated web there is the equivalent of 3,000 filament. The gas admitted to the center of this filament bundle—burns throughout the mass, something after the order of surface combustion. I am going to turn the electric fan on those pilots, and I want you to notice that the end pilots, the glowers, are not affected, and are not blown out. This fan at this high speed delivers a blast of about 16 miles an hour, so you will get the idea that we have a pretty strong draft on the pilot lamp.

(Mr. Litle directed the draft from the electric fan on the board containing the four tiny lights, and the two center lights were immediately extinguished. Placing the fan very close to the board the further pilot light, a glower, was extinguished.)

We put out the end pilot finally and we find the last one burning is a glower.

Of course it must be remembered that the pilots are never subjected to a draft like this in a room; this is merely a rather spectacular way of showing the device.

You will find by actual test in the laboratory that this pilot will stand about thirteen times as much draft as an ordinary open-flame pilot burning about twice as much gas; in other words this pilot burns about half as much gas as the ordinary pilot, the consumption being about 1/20 of a foot per hour.

To show you how little gas they are burning, I am going to take this off, and you can just barely see the little flame. That is the amount of gas we are using in this particular pilot.

It occurred to us that possibly this glower might be used for other purposes, such as the production of a gas sign, and we have there a sign merely suggesting an idea. That sign is burning 3 feet of gas per hour, being a very cheap form of advertising device, which would cost about ⅓ of a cent an

hour to run. It might be used in store windows in the same way that these little electric letter signs are used in such places.

THE CHAIRMAN: Some of the gentlemen to whom I wrote for discussion were unable to be present, but their discussions are sent in, in a written form. However, I think the best method is to let the iron be stricken while it is hot, and I suppose there are those present who would like to discuss this now without any intervening discussion. The paper is open; there must be questions you would like answered.

MR. GEO. BEADENKOPF (Baltimore): Do you light each one of these tips in a sign of that kind?

MR. LITLE: You turn the gas supply off, then turn it on full, and afterwards adjust it down.

MR. H. M. RILEY (Baltimore): I would like to ask Mr. Litle what would be the effect of lowering or raising the pressure on a glower? Also, whether the blast action gotten in a lamp when the main light is extinguished would be exactly the same as the blast action he showed us by means of the fan, with the device he has rigged up on the mantlepiece? In other words, might not the explosive action of the gas going out, be of a different nature and considerably stronger than the blast produced by that fan.

MR. LITLE: No. We found that the fan test is very much more severe than that action, because ordinary pilots will stay lighted pretty well under those conditions, but the ordinary pilot will not stand the blast that we here subjected these to.

MR. W. F. CLAUSEN (Winona): May I ask if there is any primary air in the Bunsen, or just plain flame?

MR. LITLE: No. We are burning so little gas that the flame within the structure is a blue flame. The flame is so small there is no yellow tip. I will show that again.

They are adjusted pretty well; that is as high as they will ever be adjusted, and yet if I take this glower off and light the flame beneath you will notice that there is only a tiny blue flame burning. If I were to turn that up very high, it would feed the ordinary pilot flame, there would be entirely too much flame for this device, as this burns only about half as

much as the ordinary pilot light. Therefore, we are burning only a blue flame, and we have no carbonizing action.

THE CHAIRMAN: Mr. Litle does that not mean in burning so small a quantity of gas you do not raise it to the temperature of incandescence as you have no primary air?

MR. LITLE: I do not quite get your point, Mr. Bond.

THE CHAIRMAN: If you turn this to a higher point, it grows incandescent; that is to say, there is a portion of the flame which gives light, but if it is turned down so low that it does not give light, does it not mean in this particular case that your flame is below the temperature at which you can get the carbon incandescent? This being due to large conduction losses which are proportionally larger in a minute flame.

MR. LITLE: It is either that, or that there is sufficient secondary air to support the combustion without the primary air. I would say with the larger flame it would not be possible to get enough secondary air to consume the gas in the same way.

MR. W. J. SERRILL: I would attribute that to the very small volume of the flame. It is so thin that complete combustion takes place throughout its entire mass. It has no interior, as larger flames have, where the heat has decomposed the gas and rendered incandescent the carbon particles.

This new pilot emphasizes the importance of supplying a uniformly thoroughly scrubbed gas. The present pilot burns about 1/10 of a cubic foot. If the pilot screw, which is in the form of a needle valve, is adjusted to burn 1/10 of a foot, the annular opening is extremely narrow and an infinitesimal quantity of liquid or solid deposit is sufficient to stop it up.

Now this proposed new pilot burns only about one-half the amount of gas that the present pilot does, and it would seem that it offers even a better chance to stop up. The stoppage of pilot lights is a serious handicap to gas lighting.

I ask Mr. Litle whether he contemplates using an adjusting screw with the new pilot or whether it can be put into use without a screw. If the gas could go through a circular instead of an annular, hole, there would be less chance of stop-

page. We need a pilot that will not go out; here is one that will not blow out, but if it is more liable to go out from other causes, it may be no improvement.

Mr. Litle speaks of this new pilot as being of service as a night light. While this may be an advantage in some cases it may also be objectionable in others. Many persons object to sleeping with a light in the room.

Mr. Beadenkopf: Mr. Litle, may I ask how those small pilot lights would be affected by a change in gravity of the gas; that is to say, suppose you were burning water gas of a certain gravity, and then changed it to coal gas or to a mixture of coal and water gas, how would the pilot light be affected by that change in gravity?

Mr. Litle: Answering Mr. Beadenkopf's question, I would say that I think all pilots are affected by this change in gravity, and it would seem that a large proportion of our pilot outage with the old time pilots is due to the effect of the change in the gravity. In other words, if you have been burning a coal gas and switch over to water gas, the flame may decrease so that it is not nearly as large as it is on coal gas, and then they are apt to blow out; it is not a very stable flame. We find that the glowers can be turned very low. In fact we have a test in laboratory where, burning in consumption 1/50 of a foot per hour, they maintained ignition there for an entire day and were not affected by the ordinary drafts in a room. That is an abnormal case.

We do not believe the glowers are going to be affected much by the change in flame volume due to the change of the gravity of gas.

And to Mr. Serrill's question, first, whether it will be possible to furnish a single orifice to regulate the flow of gas to the pilots, rather than use the needle valve in the opening, and eliminate this very small annular opening you get in the case of the needle valve? I would say that we tried in the laboratory to reduce the hole so small that it came almost to the vanishing point. An orifice 1/2,000 of an inch in diameter furnishes too much gas for this device. We made a drilling

on a precision lathe and drilled a hole 1/1,000 of an inch in diameter, and that furnished too much gas. We supply a little filter box, passing the gas through a fluffed asbestos, and then there is no pilot outage due to the deposit on the screw, the filter, of course, being placed on the service side of the pilot adjustment. You cannot see a trace of deposit on the needle valve, in the case of this outage, but it surely must be there. However, in a case of that sort if the screw is examined after being in service 2 or 3 weeks, you can rub the point on a clean handkerchief and see a little gray deposit. You can readily see that if an orifice 1/1,000 of an inch passes too much gas, the annulus around the needle must be much smaller.

One more question asked about the objection to the illumination given to this device in the bedroom. I think there would be objection in some bedrooms. Perhaps in such places you could not use this device. But in my experience in my own home for about a year, it has a decided advantage. At night I can walk from room to room, with no necessity for turning on the lamps.

In a bathroom, for instance, it is extremely valuable. If you came in the room at night, I could readily distinguish you. It gives slightly less than 0.1 of a candle-power, or roughly, 1 lumen. To give you an idea what that means, it is possible to read a newspaper with an illumination of about 0.01 of a candle-power.

Mr. Serrill: I am convinced if gas lighting is to be adequately developed, gas companies must cease the practice of supplying coal gas, then jumping over to water gas, and again back to coal gas, just as it suits them. We must come to a very much more uniform product than we have been accustomed to. Happily, the present strong trend to a heat unit, in place of a candle-power standard, is going to put the gas company in better shape to do this—not only to supply a gas which is more uniform in quality and gravity, but also to supply a gas which contains less of these objectionable hydrocarbons which are apt to cause trouble, especially in the pilots, to incandescent gas lamps.

Mr. Riley: Mr. Chairman, just to bring out another point. I noticed when Mr. Litle lighted the sign he had to carry the match from one letter to another. Now, the practical aspects of these signs would be that they would be located very close to the front window and sometimes in the bay window of a store. If you ran across a man with a name something like Schwartzwalder, it might take several matches, and not a little inconvenience to light a sign of such a name. Incidentally, the fact that the sign would be located very close to the window-pane would cause some more inconvenience in lighting.

I might bring out a point along this line, which is possibly old, and then again may have a little originality. We have found in our laboratory, when testing certain makes of luminous flame heaters, that you can light every other one of the tips and they will burn for a space of 24 hours if you care to burn the heater that long, and every other tip will be burning, and every other tip giving off unburned gas. We overcome this condition when testing a heater, by taking the burner, and putting on the sectional end of it a quadrant whereby we can measure any angle. Then by turning the burner we find a certain angle, at which we can make the burner light along its entire length. That is by placing a match at any tip the combustion will carry to all the other tips. This might possibly have some bearing on the glower sign; that is, you could turn those tips down to a certain angle, and still not destroy the good looks of a sign.

Mr. Litle: We might also use a flash pot so that it would light it all at one time, and that is a commercial possibility.

Mr. Wm. F. Clauson (Winona, Minn.): I do not agree with the remark made in regard to the small consumption of gas and the gas used by the companies throughout the country, especially in the small gas companies. It would have an important bearing upon the advisability of using these lighters. I think the trouble we have now comes from the causes that Mr. Serrill has enumerated, and I think if we are going to use one-twentieth part of this, we are going to have more trouble than we are having at the present time. How are these lighters to be applied to the inverted type of burner, on the outside

or on the inside of the mantle? If on the outside, if this takes up as much room as I see it, are we not going to have more breakage of glassware than we are having now with the outside lighter?

Mr. Litle: I think glassware breakage is one thing that is eliminated, because here we have such a small flame, and so little heat; we do not have the long pilot flame burning horizontally across into the glassware. That is one great drawback to gas lighting at the present time; the long pilot light necessary at times for ignition, and sometimes on increasing pressure these pilots are lengthened. In the case of an increasing pressure this pilot is not further lengthened. It may be a little fuller; there may be an excess of gas from the glower, but it never lengthens to a point where it will break the glassware. When applied to inverted burners or inverted arcs the glower is fastened to a straight section of clay tube, and that in turn is telescoped into a clay body piece, the clay body piece being very similar to the clay pilot tips now used in such lamps.

Of course, in those inverted lamps we encounter higher heat. Some types of lamps, where the heat is low, we use a metal tip; those that you see have metal tips.

Mr. J. Arnold Norcross (New Haven, Conn): (Written discussion communicated.) Mr. Litle's paper deals at bottom with the most fruitful source of lost gas lighting business.

Modern gas lighting has in its favor efficiency, quality, color, and dependability of service, but it still suffers from other weaknesses, the greatest of which is lack of convenience with particular reference to means of ready ignition.

An investigation into the reasons for giving up the use of gas lighting shows that the difficulty of obtaining attractive fixtures which will retain their finish, the question of injury to decorations (now happily largely overcome by modern gas lights), and the trouble of adapting gas to convenient use in many locations, have a good deal to do with the decision. But the point which counts most is convenience in ignition. "Switch it on—no matches" sums up the uppermost idea in the ordinary consumer's mind.

A method of ignition of gas lights must be found which is *as certain* and *as convenient* as the turning on of electric light before gas lighting can regain its prestige and get full credit in the public mind for all of the virtues it now possesses.

If the new pilot described by Mr. Litle fulfills these conditions, if it is at the same time lasting and is inexpensive to install and operate, a new era of gas lighting awaits us. Let us but devote proportionately as much energy and money to conserving and advancing the lighting business as we do to the fuel business and the next few years of gas lighting will be a triumphant progress.

Mr. Philmer Eves (New Haven, Conn.): (Written discussion communicated.) It has seemed to the commercial men of the gas industry that with all its advantages gas lighting needed nothing more to command enormous increase in lighting of residences, stores, and every kind of building. The various systems of control adopted have been satisfactory up to a certain point but it has been this "certain point" which probably needed more attention than all the other problems connected with the operation of gas lighting appliances.

The jump spark system of ignition has been used with success in buildings where a large number of lights have to be ignited at the same time. The magnet cock has been found to be practically instantaneous. The pneumatic valve and the filament ignition systems have been adopted in many places but we all realize that with the best of these ignition systems there was more or less uncertainty. Indeed it is probable that this uncertainty is the only feature which has not secured the enthusiasm of the salesmen of gas lighting.

The gas industry is under a deep debt of gratitude to Mr. Litle for the immense amount of work which he has put into this most important problem.

The claim of the electric companies that the pilot light on the gas burner must be constantly consuming gas to some extent, however small, would appeal to the lighting patron who had it in mind that there was no expense at all when the electric button had been turned off. It is not the single pilot that

counts against the success of holding the gas lighting business but the aggregate cost of a large number of pilots burning continuously.

It is therefore extremely gratifying, while gas lighting is beginning once more to take first place as the ideal lighting system, that still greater perfection is about to be attained.

The saving in maintenance expense occasioned by the apparently absolute dependability of this new system will also appeal to all gas men.

THE CHAIRMAN: We will now pass to the second paper of the session, which deals with a subject of vital interest to all gas companies who intend retaining and developing their lighting business, "Chicago's Experience With a Separate Lighting Division," by Mr. Charles A. Luther.

MR. CHARLES A. LUTHER (Chicago): Mr. Chairman and gentlemen, it is unnecessary to take up your time with the full paper, so I will abstract it in such a way that it will only touch on the fundamental principles laid down in the paper.

From experience it has been demonstrated that a separate lighting division is as essential to the gas business as a separate department for the hotel and restaurant or industrial divisions.

The present day articles published in the different trade journals has made it absolutely necessary for the salesmen of the gas company to be lighting experts, and without the necessary information pertaining to illumination, it would be practically impossible for the gas company to do business with a good many of the up-to-date merchants who are thoroughly posted on all phases of their business and especially so on artificial illumination, inasmuch as it is one of the most essential things of their business.

In forming a separate lighting division, as well as picking the men for this division, they both must receive considerable thought on the part of the managers of gas companies. The size of a department will, depend upon the area and population of the districts supplied. Primarily it is necessary to have a competent manager for this department who should have the necessary assistants, special men and salesmen to

make the proper showing that the districts supplied with gas should show.

I might also state that it is essential from time to time to shift the men around. We have found from actual experience in Chicago that a man staying in one territory too long has a tendency to show less returns than when we shift the men from one territory to another.

Another thing is the formation of flying squads. We pick out one day each week, and the men in their respective districts form into what we call flying squads and canvass a street thoroughly. The same day next week they continue on where they left off; and in that way we are sure that every street, every business place is thoroughly canvassed. Any prospects that might accrue from the canvass men are turned over to the man in whose territory the prospect emanates from; at the same time, any orders that the men get in that fellow's territory, they receive their commissions on. We have also found it is an advantage to make the man "sit up and take notice" in that district or territory, because if he can skip around and get all the orders he is sure that they are not going to make much of a showing on a flying squad; but they do not get them all.

The assistants, special men and salesmen should be picked from those departments that come in close touch with the public, unless it is deemed advisable to secure men from other sources, men who have had sufficient training in the lighting field.

The idea of picking men from the departments that come in contact with the public, is simply because they know how to approach the public and talk to them.

A salesman is a direct representative of the gas company to the public, and therefore, should be neat in appearance, have a retentive memory, and also have the courage necessary to face his prospective customers.

The pay of these men should be based on their earning capacity, or in other words, they should receive a salary and a commission. The commission is an incentive for the men to

turn in more business, for increasing their sales is conducive of increasing their salaries.

We have had a good deal of experience in Chicago in paying men. We have had men on salary and commission, and straight commission. We find that the men on salary and commission are working for the company's interests first, last and always. The men who are on a commission basis have a tendency to pick up such business where they can secure the largest returns. For instance, in Chicago we pay a commission on every gas arc lamp order secured. I might state, too, that if possible we talk a man out of buying a gas arc light in Chicago; in other words, our aim is to rent every arc lamp that goes out, and take care of them.

On a salary and commission basis the salesman receives 50 cents commission on every arc lamp order that he takes, or rather on every individual arc. The straight commission man receives $1.50 an arc lamp. On a succession arc lamp—and by succession I mean arc lamps that are left in the store after a tenant moves out and where the salesman goes back after the new tenant has moved in and secures his order—the salary and commission man receives 25 cents, and the commission man receives the same amount; it is the same on retain. That is, where a consumer orders his arc lamps removed and our salesman calls on him and retains the business or keeps the arc lamp in or gets their signature to an order, they receive 25 cents commission.

On all other materials sold, such as jobbing orders, piping installations, fixture orders, or small lighting orders, the salary and commission man receives 5 per cent., and the commission man 10 per cent.

Now, paying the commission man $1.50 on an arc lamp, and a salary and commission man 50 cents in addition to his salary, is a great incentive for the commission man to secure all the arc lamps he can and forget his retains and succession.

The salesman should be educated along the lines of the work they are doing. This can best be accomplished by giving them a schooling in the particular line in which they are working.

Any man in the lighting division, should after a reasonable time, become so proficient that he could easily be classed as a lighting expert, for in this advanced age, merchants or manufacturers, prefer to deal direct with experts.

In addition to the educational features, each man should be supplied from time to time with data pertaining to both gas and electricity, furnished in a suitable size so that he can readily carry it with him to show to his prospective customers at any time the necessity may arise. The salesman in a department of this character should be versed in the amount of business both profitable and unprofitable that they are doing each month of the year. For this reason we have adopted an efficiency record whereby we show the number of arc lamps installed and removed each month, and in addition we show also the number of succession and retained lamps, as well as the salary earned by each salesman every month. With a record of this character it is very easy to point out to a man where he has been doing exceptional work, or we can show him the reverse where he is unprofitable. This record has a good influence over the men, as invariably, after calling a man's attention to his poor record, he will immediately start to do better.

To show profitable returns to a company that supports a lighting division, it is absolutely necessary from time to time to bring out new ideas in the way of special equipment for gas arc lamps to apply to special installations, and then specialize on those different types.

We have had exceptional results with our daylight arcs brought out about 2 years ago, which up to the present time have netted us an installation record of over 8,000 arcs. These units are, installed at all places where color matching is necessary. Practically any of the places where these units are installed would be pleased to furnish us with a testimonial letter covering their particular installation, as invariably, they state that it is the only unit that has ever given satisfaction from a color matching standpoint.

I might state that in speaking of the daylight gas arc, some of you might recall—I think it was 2 years ago in New York—

the matter was brought up and discussed after we had been installing arcs for possibly 3 or 4 months, at which time I gave full information in regard to the daylight arc. The matter has been investigated by a good many gas companies, we have received many communications, and the lamp manufacturers have received the same; but at the same time it is surprising to know how many gas men there are who know nothing about daylight gas units.

A very short time ago, a man who was assistant manager of the Regensteiner Colortype Company in Chicago where we had our first installation of daylight arcs, after they had tried all kinds of electric units, secured a position in another large city, and upon taking charge found that they were using electrical units exclusively. He wanted daylight gas arcs installed. He went to the local gas company and asked them if they knew where he could secure the daylight arcs, or whether they could supply them. The gas man told him that they knew nothing about them, they had never heard of the daylight gas arcs.

That man came all the way back to Chicago and insisted on buying the gas arcs from our company to be installed in his factory.

I do not believe the average gas man actually realizes the importance of this unit. There is not a colortype establishment in the City of Chicago, or hardly a color-matching establishment that does not use the daylight gas arc. It might be of interest for you to know that a large retail store that is known from one end of this country to the other has just recently placed an order with us for 218 of these units which is only the first order, and which will be followed by a total, as near as we can guess, in the neighborhood of 1,000 gas arcs. That is Marshall Field & Company, and they are being installed now.

A MEMBER: Is that the main store?

MR. LUTHER: That is the retail store down town, and they have not yet touched the wholesale.

In speaking so much about the daylight unit, do not think that I get any profit out of it, because I do not receive a cent, only the salary I am getting from the company I am working

for. I mention this as there might be a few skeptical ones who might not realize the importance of this unit, and I want to emphasize it.

I have here an unsolicited testimonial that might be of interest to you. It is "The Permanent Exposition of Works of Art, Old Masters and Modern Paintings." And this gentleman, Professor Eugene Califano, has a national reputation. This is what he states:

Chicago, Ill., Aug. 24, 1915.

"The People's Gas Light & Coke Co.,
"No. 122 South Michigan Boulevard,
"Chicago, Ill.

"Gentlemen:—

"The daylight gas arcs, which I am using in my studio and art gallery are more efficient than any other light which I have had. When I paint at night I get very good effects on my colors. Now, you know in painting it is pretty nearly impossible to paint by artificial light.

"I take this means of recommending your daylight gas arcs to any person who requires light for artistic purposes to show color values.

"Yours very truly,
"Eugene Califano,
"Artist."

I might also state, that in one of the windows of the gas building on the corner of Adams and Michigan Streets we have one of these daylight gas arcs installed. Do not misconstrue it when I say "daylight gas arcs." The only difference is in the glass and in the mantle. The lamp body is the same standard unit that everybody is familiar with.

I might also say—I am just trying to bring out the important phases of it—between 94 and 95 per cent. of the daylight gas arcs installed, has displaced electricity.

We have also been very successful in the installation of special reflectors, constructed by us for the equipment of units installed in photo studios, picture galleries, etc. The construc-

tion of these reflectors is not expensive and the returns secured warrant us in manufacturing our own reflectors.

On July 1st, 1915, we originated a gas arc sign which required one arc lamp for each letter in the sign. Up to July 1, 1916, we have installed 282 of these signs, making a total of 989 gas arcs, or an average of a little over three and one-half lamps per sign. These signs are equipped with from three to nine lamps each, and project over the sidewalk in most instances, but in a few cases where they have a sign restriction, as the City of Chicago has in certain districts, it is necessary for us to run them parallel with the building, or what is commonly known as a flat sign.

Do not think when I say 989 arcs, that is all the outside arcs we put in in one year. This is simply the gas signs we have installed. We have gas signs installed that run as high as nine lamps to a sign.

Everything I have spoken of so far has covered nothing but arc lamp installation, because I think that branch is one of the primary things that we should energetically push. It means the largest returns to the company, but at the same time we must also look after our small units. We still run our special campaigns on the small units, and also from time to time get out new fixtures. We have recently put out a new line of fixtures that are interchangeable and in my estimation the thing that the gas man has been looking for. Every one of our branch stores and hanging stores are equipped with them. You gentlemen can look back to your shelves and see the number of fixtures you have there covered with dust, tarnished, and you cannot move them because they are not the kind of a fixture to move.

We were in the same predicament. We have just removed out of our branch stores—I would not want to say how many thousands of dollars worth, but a tremendous big stock of fixtures that we could not move, and placed them in our storage. These fixtures we have just installed or just displayed are so arranged that you can make any kind of fixture you want out of them. They all come in four-light bodies.

There is no necessity of a three-light fixture. The only place a three-light fixture should be used is in a triangular room, and we never have a triangular room. The two- or four-light fixture is the proper fixture, and we can make either one from the same fixture.

In conclusion I might state that we have shown such exceptional results in th e past 2 years in our lighting division, that it has demonstrated that a lighting division should be installed by all gas companies that are sufficiently large to maintain one.

CHICAGO'S EXPERIENCE WITH A SEPARATE LIGHTING DIVISION.

I. The necessity of a separate lighting division.
II. What should constitute a lighting division.
III. How the men for this division should be picked.
IV. How should the salesmen be paid?
V. Educating the men to become lighting experts.
VI. Furnishing the men with data.
VII. Keeping an efficiency record.
VIII. Specializing on special equipment.
IX. General.

I. The Necessity of a Separate Lighting Division.

It has been fully demonstrated by several large gas companies that a separate lighting division is a necessity, especially where there is a contention between the gas and electric interests to secure the business patronage of the prospective consumers by offering more advantageous equipment as an inducement to secure their trade.

That competition is the life of trade has been demonstrated time and again, but if the gas industry wants to increase its output through the medium of gas lighting units, as well as to hold the lighting business it now has, it must not only meet competitors half way, but must go them one better, for both the gas and electric interests are working for the same ultimate goal—to show the superiority of their respective commodity.

The day when each salesman or representative of a gas

company sold all types of gas burning equipment, from the mantle burner to the hotel and restaurant or industrial appliance, is past. Most gas companies of any size now have a separate department that takes care of the hotel and restaurant and industrial, and another department that takes care of everything else including the lighting business.

The reason for taking the hotel and restaurant as well as the industrial appliances out of the hands of a general salesman, should also act as an incentive to start a separate lighting division to exploit everything pertaining to gas lighting, for, specializing on any particular gas consuming unit is bound to bring more returns for the amount of energy exerted than can be accomplished when a salesman handles all kinds of appliances. A general salesman not only takes the path of least resistance by selling the easiest selling article, but also jumps from one gas consuming unit to another to the confusion of the prospective consumer.

Practically all kinds of wholesalers as well as retailers subscribe to some trade journal that has incorporated in its pages certain articles as well as advertisements that pertain to their respective business, and it is only natural that there should be articles on lighting in these different journals, inasmuch as it is of great importance for the merchants to know about one of the most essential things pertaining to their business, artificial illumination.

This being the case, there is no reason why we should not have a special force of men who are thoroughly drilled into knowing what is the proper type of lighting unit to use for the different classes of service they are to be used for, as well as the proper spacing and installation of same, and who can also converse instructively with the prospective consumer about all technical terms pertaining to the art of illumination.

I hardly believe that there is an official or manager of a straight gas company who will not substantiate my statement when I say that the lighting business is one of their most important branches and should receive as much consideration if not more than that accorded to other divisions.

II. What Should Constitute a Lighting Division.

The number of men in a lighting division will naturally be governed by the size of the gas company, the area and population of the city and the ability of the division to secure the desired results.

In Chicago we are securing exceptional results from a lighting division that is composed of the following men:

Manager, who has charge of the lighting division and who is responsible for the operation of same.

Two Assistants.—One of these assistants takes care of all office work, such as the proper routing of all orders, checking the salesmen's daily reports as well as assisting the manager in any of the special problems that might come up, pertaining to the general routine of the department.

The other assistant, assists the men who are out in the field, on any installation that needs special attention, as he is a man who is possibly better qualified to handle a special proposition than the man who is out in the field; he also does any special work for the manager.

Two special men, whose duties are to follow up all our lamp remove orders that have been O. K.'d for removal by the salesmen in their respective districts. When arc lamps are put out on a rental basis in such large numbers as they are in Chicago, it naturally means that there are a large number of removals to take care of, not only where the consumers contemplate changing their method of illumination, but also where buildings are being wrecked or remodeled or consumers are moving from one location to another. In a large number of places where our arcs have been ordered removed by the salesmen on account of being displaced by other lighting units, these special men have been very successful in not only retaining the business by getting the consumer to cancel his order for other units, but in a good many instances have also secured orders for additional arc lamps. The work of these special men has halted to a great extent the number of remove orders inasmuch as the regular sales-

men will work so much harder to retain the business before they pass the orders over to these special men.

Three Supervisors.—In Chicago we divide the city up into three districts known as the *North, West* and *South* districts, each of which is in charge of a supervisor, whose duties are to supervise the work of the salesmen in their respective districts, check up their work and in general to see that the men do the proper amount of work each day.

Necessary Salesmen.—The different districts are divided up so that each supervisor has from eleven to thirteen men under him.

The districts are sub-divided so that each man will have an equal amount of business prospects and should allow them to show about the same results in their daily or monthly returns, providing the different salesmen have approximately the same ability.

A *clerk* is necessary to tabulate the daily returns and furnish the manager with daily and monthly reports, as well as to keep the supervisors supplied with all the necessary stationery and prospects that are referred to this department.

Last but not the least, there must be a general meeting room where the men can get together as often as necessary. In Chicago the men report at this meeting room every Tuesday and Friday morning. The other mornings throughout the week they report to their supervisors at one of the branch stores in their respective districts.

In this general meeting room we have a large blackboard that extends across the front wall of the room. The board is sub-divided into a space for the men's names and a space for each day of the month. On this board we keep a record of each man's daily report of the amount of arc lamp business he secures.

We have found that this board has acted as an incentive for the men to do more work as it stares them in the face at every morning meeting held here.

III. How Men Should Be Picked for This Division.

Manager.—The manager must be thoroughly competent to figure out any kind of a lighting problem, he must be able to organize and manage a department so as to secure the desired results, he must also have the ability to originate and construct special equipment for different classes of business, and last but not the least, he must know all about electric units as well as gas units.

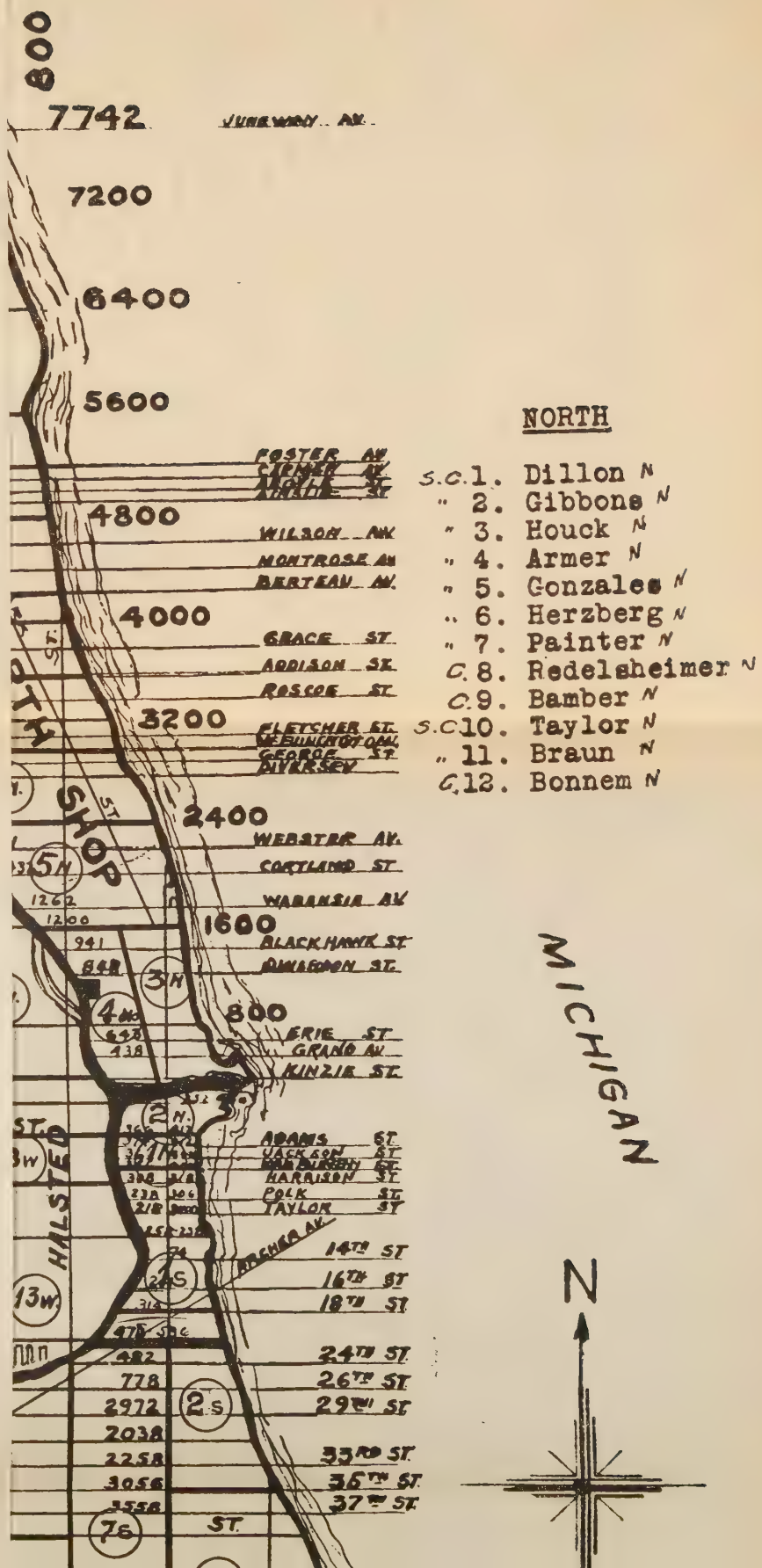
Assistants.—The assistants must be men who have had a good deal of experience, preferably men who have good selling ability and have a good knowledge of the art of illuminating engineering.

Special Men.—These men must be thoroughly versed in the candle-power and cost of operation of both gas and electric units, as well as the characteristics of different types of shades commonly used. They must also have the ability to convince the consumer that they are capable of handling any kind of a proposition pertaining to illuminating problems.

Supervisors.—They must be capable of managing men to get the best results out of them and must be able to figure out lighting problems of all kinds, so as to assist the salesmen whenever it is necessary.

Salesmen.—Great care should be taken in selecting these men as representatives of the company. There are certain things that should qualify them for this position; primarily they are: They should present a neat business-like appearance for the first impression they make on the prospective consumer goes a long way toward securing his business; second, they must have good judgment as well as a retentive memory; third, they must have courage, commonly called nerve; fourth, last but not the least, if they are to be selected from the employees of the gas company they should be taken from those departments that come in daily contact with the public.

Salesmen having these necessary primary qualifications should next be taught the rudiments of illuminating engineering so that they can gain proficiency as lighting experts.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" 2. Gibbons N
" 3. Houck N
" 4. Armer N
" 5. Gonzales N
" 6. Herzberg N
" 7. Painter N
C. 8. Redelsheimer N
C. 9. Bamber N
S.C. 10. Taylor N
" 11. Braun N
C. 12. Bonnem N
N

Clerk.—He can be selected from the office boys, providing he is bright, writes a good legible hand and has the ambition to work for advancement.

IV. How Should the Salesmen Be Paid?

The method of installing gas arcs by different companies will regulate the way salesmen should be paid, so instead of making an analysis of the different methods, I will confine myself to the system we have adopted in Chicago.

We have been experimenting for the past year by paying some of the men salary and commission, and the other men on straight commission.

Before going into details, it should be remembered that we rent and maintain all gas arcs we put out.

The salary and commission men are paid as follows: They receive a stated salary and on all arc lamps *rented,* 50 cents each; on *succession* lamps, that is, where a party moves in where our arc lamps are already installed (we leave our lamps in any place where they are safe) we pay 25 cents commission; on *retained* lamps, that is, where a consumer notifies us to remove our gas arcs and the salesman secures his signature to the remove orders, agreeing to retain the lamps, we pay 25 cents per lamp and for all other business he secures such as fixtures, piping, etc., we pay him a commission of 5 per cent.

The straight commission men receive $1.50 on all *rented* lamps, 25 cents on *succession* lamps, 25 cents on *retained* arc and on all other business 10 per cent. commission.

The manager, assistants and special men are on straight salaries, but the three supervisors salary is based on the amount of work his salesmen do; he is paid the average salary of his men plus $15 per month.

From actual results, we find that the salary and commission basis gives us greater returns for the money invested than we receive from the straight commission men. The salesmen on salary and commission will pay more attention to successions

and retains, while the commission men pay more attention to the items that bring in the most money.

The practice of paying the supervisors the average salary of their men plus $15 per month, is an incentive for them to see that the men who come under them do as much business as possible for the greater the salesmen's returns the greater the returns of the supervisor.

V. Educating the Men to Become Lighting Experts.

We have been very successful in educating our lighting division men so they can be classed as lighting experts, by means of the following system.

We furnish each man with a course in illuminating engineering compiled by us, which is divided into different sections; each section has from ten to twenty questions covering the most important features of each section. These questions must be answered and are checked over by the manager or one of his assistants and if any of the questions are answered incorrectly, it is explained thoroughly to the salesman so he understands it clearly.

In the winter time we hold evening meetings twice a month and once a month in the summer time. At these meetings we have a free discussion on all phases of the lighting business. Gas and electric lighting equipment is thoroughly analyzed and we draw imaginary plans on the blackboard which the men equip with the proper gas outlets and an itemized list of the necessary lighting units to be installed, their spacing, the height at which they should be installed and the cost of operating them, specifying the cost per day, per month and per year, including the pilot consumption and the rental of same.

At some of the meetings, we appoint one of the men as a gas salesman and another man as an electric salesman and require them to come in separately and call on either the manager or one of his assistants, who are supposed to represent a merchant, and present their proposition for lighting an

imaginary loft or store; then they are called in together and are allowed to get in on the final arguments for gas or electric equipment.

This has been conducive of teaching the men the selling arguments of both gas and electricity, inasmuch as the men in this department are required to criticise any blunders or omissions that either of the men should make and as the men do not know who will be called on until the night of the meeting, they naturally keep themselves primed at all times on both the gas and electric units.

At our morning meetings in the general meeting room, we take up a good many things with the men pertaining to their daily work that can also be treated as of an educational character.

VI. Furnishing the Men with Data.

Each man is furnished with a loose leaf handbook that is supplied from time to time with blue print sheets covering some phase of our daily requirements.

Up to date, the men have the following sheets in their handbooks:

1. Cuts and rental prices of all gas arcs we handle.
2. Cross section diagram sheets for plotting out the location of gas units.
3. Sheets showing the different fixtures we sell.
4. Blank sheets for keeping a record of their calls and any other memoranda.
5. Blue print of bowling alley showing the type of units to be used and their proper location.
6. Blue print descriptive of the height and location of units for lighting pool and billiard tables.
7. Blue print, showing equipment and giving prices of fixtures and units for pool and billiard table lighting.

24"
11"
2"
LUNCH
—To be hung 10 ft above Side-walk.—
—Gas Arc Sign.—
The most efficient sign upon the market as it not only acts as an effective sign but also Brilliantly illuminates the front of building, side-walk and Street.
Cost to Operate .01 cent per hour per lamp.
Cost Installed & Maintained $1.00 Per lamp per Month.
City inspection Charges Paid by,
—The Peoples Gas Light & Coke Company.—
C.M.L.-9/1/15
Peoples Hand Book.
No. 8.

PLATE 2. -Sample of Blue Print.

8. Blue print, comparative table of costs to operate gas arcs and tungsten units, for 1, 2, 3, 4 and 5 hours per day, per month and per year, also giving the efficiency of each unit by the cost per candle-power per year based on 5 hours per day.
9. Blue print, showing cost of operation of nitrogen units.
10. Blue print of safety first combination gas arc and sign equipment.
11. Blue print of photo reflector with plan showing how gas arcs thus equipped should be installed.
12. Blue print of chart showing number of light and dark hours each month between the hours of 6 A. M. to 10 P. M. and the number and percentage of hours for total light and dark hours per month.
13. Blue print showing a typical gas arc sign with the word "Lunch" on it, and the method of installing same.
14. Blue print of candle-power *vs.* heat units, showing in a diagrammatic way the candle-power of open flame and mantle burners.

These blue prints have been of considerable benefit in helping the salesmen to secure business.

In addition to these blue prints, the men copy any data that they may secure from either the morning or evening meetings, on their memorandum sheets in their handbooks.

VII. Keeping an Efficiency Record.

We keep an efficiency record of each man's work for each month in the year, which has been of great benefit to us in being able to tell not only which men are doing efficient work, but has also been of great help in increasing the salesmen's returns.

From the following chart you can readily see that there are fluctuations each month in the amount of salary and business each man secures per month.

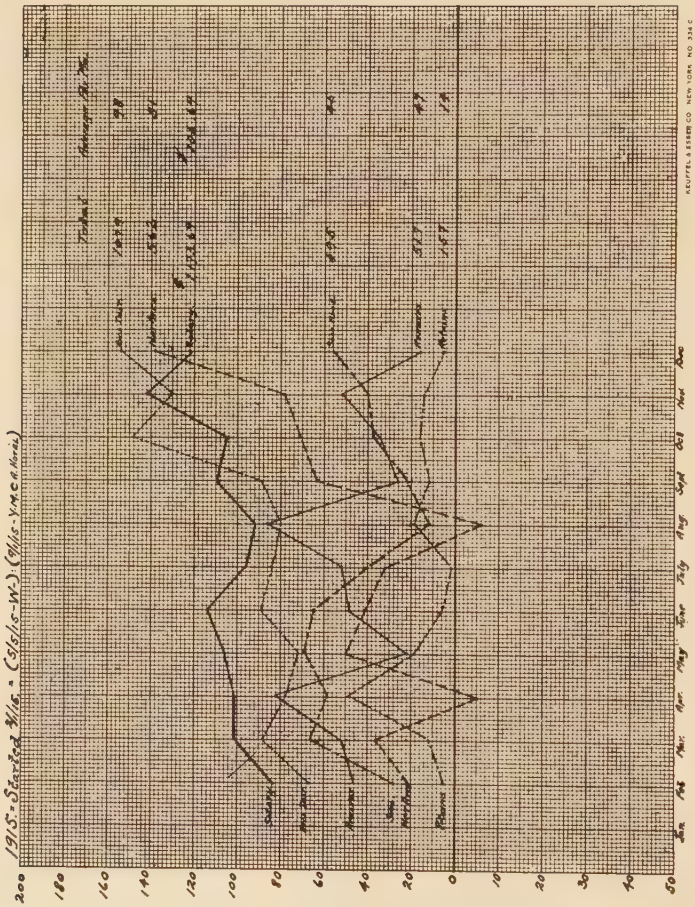


PLATE 3.—Picture of a Typical Efficiency Sheet.

On this chart we show a record of a salesman's salary, arc lamps rented, arcs removed and net arcs, as well as succession and retained arcs. The chart is divided by a line that is termed by the men themselves as "The dead line." Below this line we show a record of where a salesman removes more arcs than he installed in any one month. Each line above this line represents two arcs or $2 and each line below represents one.

Every time a salesman's efficiency record shows that he has not been doing the proper amount of work, he is called into the office and his work is analyzed for his benefit. If he has removed more lamps than he installed, the record below the "dead line" looks twice as bad as it really is, as the ratio is 2 below the line to 1 above it.

We also have a sheet that shows a total of what all the salesmen have done each month, but of course on this sheet we have no necessity of a "dead line."

The "Dead Line."

There is a reason for the men calling this line the "dead line," for if they have a habit of going below it, it is a sign that their services are no longer required. Three warnings a year is sufficient to dispense with their services.

Of course we overlook certain removals where it was absolutely necessary to remove them; for instance you will notice by referring to the above efficiency sheet that in the month of April there were five more lamps removed than installed, and by referring to the upper left hand corner you will see the date 5/5/15 and the notation "W" which means that on this date the salesman received a "warning" that he must do better, and after the date 9/1/15 the notation "Y. M. C. A. Hotel" which means that the reason for so many lamps being removed in the month of August was due to wrecking the buildings surrounding the site for the new Y. M. C. A. Hotel.

In January of the following year each salesman is given a blue print of his previous year's work, and requested to go

over it from time to time, to see whether he is improving in his work.

VIII. Specializing on Special Equipment.

To keep gas lighting units constantly before the public it is absolutely necessary to originate new ideas that will appeal to those people who are in need of special equipment for their particular kind of work.

Daylight Gas Arc.

A little over two years ago we realized the necessity of producing a unit that would allow the public to accurately judge comparative shades of silk, ink, paper, cloth, etc., and at the same time give them a unit that would allow for a general distribution of light instead of the concentrated or spot lighting effect afforded by the electric units that were then in use.

The result was that we introduced the "Daylight Gas Arc" which had been scientifically worked out after about one year of experimenting, with the result that we secured the perfection we desired by producing glassware and mantles that gave us practically the same balance of red, yellow, green, blue and violet rays as found in daylight.

The result has been more than we anticipated, for in the past two years we have put out over 8,000 of these units and have them installed in most all places in Chicago where they need a unit of this type and have a good many unsolicited testimonials covering them.

Knowing that we had a good many lamps installed that would have to be changed if we brought out a complete unit, we simply arranged to equip the regular arcs we were installing with the mirror shade, special globe and mantles, which allowed us to change the equipment of arcs already installed, wherever it was necessary.

PLATE No. 4.—Photo of a Tailor Shop.

PLATE No. 5 — Photo of Pathescope Shop.

PLATE No. 6 — Photo of Corset Cover Shop.

Special Reflectors.

There are certain places where it is necessary to provide special reflectors, such as photo studios, art galleries and any place where they desire the light to be concentrated in any particular spot or place.

We have met with very good success in installing reflectors like those shown in the above picture. In most cases they are used without daylight arcs and as the reflectors are adjustable for any angle we can distribute the light wherever the consumer desires.

Knowing that there was a demand for safety first equipment, we originated the combination gas arc and sign unit as shown in the above picture. The gas arc is equipped with a red glass skirt that is very effective at night and as the regular globe is either clear or opal glass, it allows a generous amount of light to be thrown downward, lighting up the sign and sidewalk beneath the unit. The way the sign is attached does not permit the lamp being affected when the wind blows. We install everything except the sign which is furnished by the consumer.

Gas Arc Signs.

Where a gas company expects to secure new outside arc lamp installations, they must originate new equipments for the various classes of business they serve, or in other words, they must anticipate the needs of the different consumers and be ever ready to assist them to make a perfect installation, an installation that will not only meet with their approval but one that will also appeal to other merchants in their immediate vicinity.

Gas companies should pay particular attention to the long hour consumers, as this is the most profitable business that they can secure.

In July, 1915, we started the scheme of installing these gas arc signs and up to the present writing have installed over 900 outside 3-mantle inverted arcs through this medium, which we would not have been able to install if we had not

PLATE No. 7.—Photo of Martin Art Gallery.

PLATE No. 8.—Photo of Safety First Unit.

PLATE No. 9.—Photo of Pool Sign.

PLATE No. 10.—Photo Bar and Lunch Sign.

PLATE No. 11.—Photo of Theatre Sign.

PLATE No. 12.—Photo "Eat Now" Sign.

PLATE No. 13.—Photo Lunch Bar Sign.

PLATE No. 14 — Photo of Billiards Sign.

PLATE No. 15.—Photo of Drugs Sign.

originated the idea of gas arc signs for that class of business, classed as long hour consumers.

These signs as shown herewith show from three to nine arc lamps and are suspended on a 1¼-inch iron pipe bracket which is braced by chains, and are properly equipped with drips above each lamp; in addition to this drip, another drip can be installed on the riser whenever necessary.

The lamps are equipped with opal globes and clear glass skirts over which is placed a wire protector to which the letters are attached. The letters are 5 inches wide by 7 inches high and are made of brass and coated with a flat black paint.

The black letters against the white opal globes make the letters stand out very distinctly not only when the units are lighted but also in the daytime, while the volume of light that is secured from the row of lamps suspended across the sidewalk, not only illuminates the sidewalk to a high intensity, but also lights up the windows, front of building and also part of the street.

It has been found that chains are the best type of support for gas sign brackets, and should be used wherever there is a chance of attaching them to the building so as not to produce too sharp an angle.

The chain supports will allow a certain amount of vibration to the units and do not allow the short sharp shocks that are produced when a stiff support is used. Particular attention must be paid to the bracing of these sign brackets, for in some instances there are six, seven, eight and nine lamps that extend in a row over the sidewalk.

The number of signs installed in Chicago from July 1, 1915, to July 1, 1916, are enumerated on the next page with the lettering on each sign and the number of signs of each kind.

Lettering	No. of Signs	No. Lamps per Sign	Total Lamps
Billiards	1	9	9
Gasoline	1	8	8
Bar-Lunch	1	8	8
Dry Goods	2	8	16
Theatre	1	7	7
Hungary	1	7	7
Tailor	2	6	12
Cigars	2	6	12
Stoves	1	6	6
Emmett	1	6	6
Reilly	1	6	6
Eat Now	1	6	6
Lunch	20	5	100
Drugs	1	5	5
5¢ Show	1	5	5
Candy	1	5	5
Billy	1	5	5
Smoke	1	5	5
Tires	1	5	5
Judge	3	5	15
Dance	1	5	5
Meat	2	4	8
Café	8	4	32
Svea	1	4	4
Furs	1	4	4
Hats	1	4	4
Fish	1	4	4
Beds	2	4	8
Pool	7	4	28
Soda	2	4	8
Inn	1	3	3
Tea	1	3	3
Bar	106	3	318
O O O	1	3	3
Eat	91	3	273
Gas	11	3	33
5-10-25¢	1	3	3
Total	282		989

Making an analysis of the data you will find that the majority of the signs were installed in front of long hour consumers, such as saloons, restaurants, billiard and pool halls, etc. Those marked "Gas" were placed in front of gasoline supply stations, the "Judge" sign in front of cigar stores and the ones with names on in front of saloons with the exception of "Emmett," which is in front of a theatre.

Dividing the 282 signs into the total of 989 arc lamps we find that the average is a little better than 3½ arcs per installation.

IX. General.

From time to time in a lighting division, you can work in new wrinkles that have a tendency to increase the returns of the salesmen.

For instance, each month the two men having the greatest number of net arc lamps installed are appointed captains and alternately pick the balance of the men for their respective teams; each of these teams try to make the best showing by the end of the month and the winning team is paid a bonus of $2.50 per man. If any man on this team shows by his monthly report that he has removed more lamps than he has installed, he does not receive any bonus.

In addition we have five prizes as follows: 1st $2.50, 2nd $2.00, 3rd $1.50, 4th $1.00 and 5th $0.50 which are paid to the men who have the greatest number of net arc lamps irrespective of whether they are on the winning team or not. We secure as good results from these amounts as we would if they were five times as much, as there is a great rivalry between the teams to see which side can show the greatest net arcs installed. It is considered a great honor to be a captain.

We also try to educate our men in public speaking, by having them write papers from time to time to be read before the whole division, and from time to time call on them to talk about some subject of importance to the men as a whole,

which has been of great benefit to the men in approaching their customers, as well as addressing business men's organizations.

All the salesmen are furnished each day with any prospects or letters that come into the main or branch offices pertaining to any business in their respective districts.

THE CHAIRMAN: If any gentleman present doubts the benefits to be derived from a separate lighting division, let us hear from him. (No response.) That seems to have answered itself. It may be we shall hear from those who are enthusiastically supporting a separate lighting division in their own towns, and have had experience similar to Mr. Luther's. There have been some written discussions prepared. We have one from Mr. C. H. French of the Public Service Gas Company, of Newark, N. J.

MR. C. H. FRENCH (Newark N. J.): (Written discussion communicated.) There is no doubt that a special department for commercial lighting in a gas company will result in a greater volume of better and more satisfactory installations than in cases where a representative has to sell all types of gas consuming appliances.

The strong competition, which has to be met in the lighting field to-day, cannot be combated by the ordinary or average appliance salesman. To gain new business or retain the gas lighting installations, which we now have, it is, therefore, necessary that specially trained and capable men of high standard be sent into this field; fully equipped with data and knowledge on the subject.

Where the lighting units are installed on a rental basis, it would depend somewhat on the size of the territory as to just how extensive an organization would be necessary to take care of the situation efficiently. A surplus of non-producers in a special department of this nature, *viz*:—assistants, clerks, supervisors, etc., become a heavy burden on the department if this expense is not carefully watched, especially so in the case of smaller companies.

The method of plotting out the city into districts and holding the representative responsible for the business in the district allotted him, is very commendable.

Judging from data and information secured, regarding the subject of compensating the salesmen for this character of work, it would seem as though a salary and commission would be most equitable to both the representative and company.

It is very important that regular weekly meetings for the benefit of the salesmen be held, during the course of which their problems and experience may be discussed. Blackboard illustrations of installations made, where unusual conditions prevailed and had to be overcome, are very helpful, and as a rule, make a deeper impression upon those present than would verbal expression.

The gas units, such as shown in the illustrations in Mr. Luther's paper, are very attractive and the manner in which they are installed appears very practical. However, there are a great many cities, which cannot install lamps or signs of any kind suspended over the sidewalk as the city ordinances prohibit this.

One of the dominating features in commercial lighting, is, of course, the proper maintenance of the lamps after their installation. In two of our large cities, the maintenance men are allotted certain territories and are held responsible for the proper maintenance of lamps on designated streets. The inspector follows up these maintenance men periodically, to insure the best service possible.

I will cite here an instance where, to save expense, instead of having special collectors to collect the monthly rentals, same is collected monthly by the maintenance man when he calls to clean and maintain the lamps. The maintenance man is held responsible for collections as well as keeping the lighting appliances in the best condition.

In cities where the electric company is independent of the gas company, and also, where the gas and electric company are under the same management, it is my opinion that we should not hesitate to recommend dual lighting systems. Especially,

in new buildings in the course of construction, gas and electric outlets should be properly placed so that either gas or electricity can be used or both combined when the customer so desires. There are on the market at the present time, gas and electric units, which are identical in design of fixture and glassware and which should be used wherever a dual system is installed.

I do not believe that we will make very great progress in gas lighting if we continue the practice of "knocking" the electric competitor. On the other hand, a like condition exists where the electric representative belittles gas lighting. We must be broad-minded on this subject and should seek primarily, in all instances, the satisfaction of the customer.

There is one phase of the lighting question which should have careful attention and thought. For example, a storekeeper has installed electric lighting units, which are very attractive and probably giving him satisfaction. A representative of the gas company calls upon him and endeavors to have the electric installation removed and gas units substituted in its stead. We must realize that in the majority of such cases, the electric units are far more artistic than the arc lamp most generally sold at this time. After the arc lamps have been installed, the customer begins to realize this fact although he may not admit it. When the gas arc lamps have been in operation for a few months, the storekeeper is called upon by a representative from the electric company. One of the first arguments, which the latter presents, is the inartistic appearance of the gas arcs. If the electric man knows his business, within a short time he will have the gas arc lamps replaced with a new type of electric fixture. The point I desire to emphasize is, that there is a continual shift from gas to electric and electric to gas, in these various stores. This is of great annoyance and expense to the customer.

If dual systems are advocated and the proper gas and electric units are installed, it would tend to obviate this very serious objection. In addition, in case of a breakdown in either the gas or electric service the customer, at all times, is in a

position to continue business, as there is seldom an occasion when both services would be crippled.

Returning to the subject of selling commercial gas units and charging a monthly maintenance fee for maintaining the lamps, or the plan of renting the units and maintaining them for a specified monthly charge, in my judgment, the rental plan is the best one to create the greatest volume of commercial lighting business.

It has been demonstrated in many cities where originally, the arc lamps were sold outright and a maintenance charge made for the upkeep of the lamps, that within a short period, many of the customers have given up their maintenance contract with the gas company and have had their own employees clean and maintain the lamps. In most instances, this proved disastrous for the reason that the employees did not know the first thing about the mechanical parts of the lamp and could not properly adjust the burners or replace minor parts, which are required from time to time. This practice resulted in the customer becoming thoroughly dissatisfied with gas lighting. Consequently, when the electric representatives called upon him, he was in such a state of mind that any proposition which the electric man offered him, would be accepted. This is why I favor the rental plan, the rental charge including the proper maintenance of the lighting appliances.

In a city in Pennsylvania (which is only one case among many), the records show, for a period of 3 years, that when the gas arc lamps were sold, the ratio of arcs to meters was 1 to 46. For 3 years following this period, the lamps were put out on a rental basis and the ratio for this time was one lamp to 10 meters.

It has been found advisable to make a yearly rental contract with the customer, the contract to contain a clause allowing free maintenance during the months of July, August and September, as the average consumer claims that he does not use his lamps during these months. However, it is found that in cases where stores are open on Saturday evening; and during storms in the summer, the lamps have to be in proper

working condition for such emergencies. In addition, during the summer period, when the windows and doors of stores are open, great quantities of dust and dirt blow in from the street and settle on the lamps. This necessitates keeping the lamps properly cleaned, not only for securing proper illumination when required, but to maintain the general appearance of the fixtures in the establishment.

It should further be borne in mind that, if a charge were made during July, August and September, a great many storekeepers, considering that they would have no use of the lamps during this period, would order them removed. However, the customer feels that inasmuch as no payments are required in that period, he might as well permit them to remain. This automatically saves the time and labor involved by the company in removing the lamps and re-hanging them in the early fall.

In keeping the accounts of a rental unit proposition, a certain portion of the monthly rental charge should be credited to the original cost of the appliance. These systematic monthly credits, will in time, eliminate the original cost of the lamp.

The life of an arc lamp, if it is maintained systematically and properly might range anywhere from 7 to 10 years. After a certain period, the cost of the lamp has practically been charged off the books and thereafter the full amount of the monthly payment may be credited to the maintenance account. When this condition exists, it will very materially reduce the cost of maintenance and a profit will show on the credit side of the ledger. If a company came out even on its commercial lighting business as regards the cost of the units and maintenance of same, it would still be a profitable business through the revenue derived from the gas consumed. For instance, a conservative estimate of the amount of gas consumed by the average arc lamp, figuring on a basis of 900 hours per year, with an average consumption of 12 feet per hour, totals a yearly consumption of 10,800 cubic feet. A gross revenue of $10.80 per arc would be derived if gas were selling for $1.00 per thousand cubic feet. This revenue should be attractive to

a gas company because the profit derived from the gas consumed is of a greater interest than the amount gained through merchandising the lamps.

If the plan employed for securing commercial lighting is that of selling the lamps outright instead of renting them, it will be found that the price of the lamp to the small storekeeper, keeps him from purchasing as many as he ought to have in order to properly illuminate his store. Hence, he endeavors to get along with fewer lamps or else install lamps of an inferior type.

Most gas companies throughout the country handle the best types of commercial lighting units and in cities where the plan in operation is to sell the lamps outright, they meet with considerable competition from others who rent fairly good commercial lighting units at 25 cents per week. This amount is collected by the maintenance man every week at the time he calls to clean and maintain the lamps. There are other organized competitors who sell the lamps at a price which includes maintenance and collect at the rate of 25 cents a week until the full amount of the purchase price is paid. This collection is also taken care of by the man who calls to maintain the lamps.

In conclusion, I wish to say that we must at all times recommend such units and service as will give the consumer the best satisfaction, even if it is necessary for us to recommend, under certain conditions, a dual system of lighting. It has been proven that a dual system has been one of the most satisfactory, from the customer's standpoint, and in many instances, the customer has used both gas and electricity to a far greater extent than he might have otherwise.

A representative should not be permitted to go out into the commercial lighting field until he is thoroughly trained and can efficiently plan an installation to meet the various requirements and difficulties which he may encounter.

A great mistake has been made, during the past, in allowing men to go out and talk commercial gas lighting when they did not possess the necessary knowledge in the matter. Good

business and territory has been lost to gas lighting and reverted to our competitors through this error.

Mr. G. W. Clabaugh (Omaha): Mr. Chairman, I felt very much gratified a few moments ago in listening to the gentleman who read the paper eulogizing the arc lamp. In the old meetings away back in 1909—just 7 years ago—in Detroit, when I had a controversy with one of the engineers, the most intimate friend I had on earth and have to-day, in which he went for me tooth and nail because I spoke of the arc lamp as being the commercial lamp of our business, he contending that the unit lighting was the proper one and most efficient, and, while I recognized from a technical standpoint he was absolutely correct, the unit system had been in use for some years and it was the new concentrated light that the merchant desired. At this time we had been experimenting in Omaha with the different mantles in order to find the one that would show colors, and in competition with the electric company, won out on this account in a large installation. My friend contended that we should keep on experimenting until we found something that was more efficient for store lighting. I told him that while we were running a kindergarten in our experiments, the electric company would be turning out graduates, and I am glad to see that my prediction then is verified 7 years afterwards by the writer of this paper.

The Chairman: I see no other gentlemen rising for discussion, and if you have any closing remarks you would like to make, Mr. Luther, we will hear you.

Mr. W. R. Addicks (New York): I would like to ask if the multi-fixture is not the one on exhibition in this building?

Mr. Luther: Yes, they have them on exhibition in the building here, but we have a larger assortment down at the Household Show, and I think it would be of advantage to any gas man to go down and see the show.

The Chairman: Mr. Luther, may I ask of you also in

closing your remarks that you will state your opinion of whether or not you are receiving additional efficiency from your lamps in Chicago, due to the higher pressure than they have in most of the other cities; and whether you have any figures you could give as to the increased erosion of the mantles, or anything of that sort.

MR. LUTHER: I have no figures here, Mr. Bond, but I know from actual experience and also testing that we do receive a higher efficiency on our higher pressure than they do on the lower; that we have found out.

THE CHAIRMAN: Candle-power or efficiency?

MR. LUTHER: Candle-power and also efficiency.

A MEMBER: What is your pressure, Mr. Luther?

MR. LUTHER: We run here 5.76. It will run about 5.7.

MR. WARING: I would like to ask if the electric people also make an electric lamp by which you can distinguish colors as well as with this gas lamp, and if the electric lamp is as good as the gas lamp, or is it inferior?

MR. LUTHER: The gentleman who read the discussion stated that the gas man should not "knock" the electric. Any statement I might make now please do not construe it as a knock on the electric. There have been a good many electric units installed in the City of Chicago as daylight units; in fact, you have seen the so-called blue daylight electric units that they are installing throughout the country. I have good cause to believe that this electric unit originated in Chicago. In Chicago they had a few daylight electric units before we started into the field. When we started our daylight gas arcs the electric fraternity laughed at us. But I notice they are getting very much into the field now and trying to install them. We have put our lamps in competition with the electric lamp, and every time have beaten them, so that the electric lamps are taken out.

In going back to that question of not knocking electric: I

think that all gas men will substantiate my statement when I say that it is not the gas man that knocks the electric, but it is the electric man that knocks the gas. I do not know, of course, what is the practice in other places, but I do not think that any fair minded gas man would have occasion to knock electricity.

In the gentleman's discussion he also referred to service. That is one thing that I kept out of my paper. I did not say anything about service because the main idea that I had was that you had to get the business before you could render the service, so I confined myself to the new business end. There are a good many combination companies throughout the country, and as the gentleman before me remarked it was a case where they had a free line or where they had two sets of representatives, that it was a case of putting up gas units and taking down the electric units or *vice versa*. I personally think in a town—I do not care whether it is a combination company or a straight company—that the company should have their direct representatives. If it is a combination company they should have their gas representatives or their direct electric representatives go out and see the public. I have heard a good many comments about towns or cities where they have combination companies where the people just simply laid down; they did not care about buying anything because they knew if they did that the same company profited. You can dispel that illusion to a certain extent—if you have a gas man and an electric man and let the two go out and fight, I will guarantee the returns will be multiplied a good many times.

The Chairman: I am sure it is the sense of this meeting that we extend a vote of thanks to the two authors of the papers this afternoon for having presented to us such important topics as they have presented.

Another written discussion has been handed in by Mr. O. H. Fogg of New York.

Mr. O. H. Fogg (New York): (Written discussion communicated.) I think there will not be many to take issue

with Mr. Luther on the statement that a separate lighting division is essential, if we are to secure and retain gas lighting business on a satisfactory basis—and I agree with him that to secure this result, the gas industry must be prepared to meet its competitors at least half way. Admittedly, gas lighting business is most difficult to secure, and most difficult to retain, yet I know that in some situations, where this fact is complained of, the installation and maintenance prices charged on lighting equipment are such as to make the road a comparatively easy one for our competitors.

In view of the competition which exists in the lighting business, the installation cost should be reasonable and maintenance charges should be particularly so, and the maintenance should be particularly good as well. Of particular importance and value are articles on gas illumination in the various trade journals. It is doubtful if any other branch of our business receives less publicity, on the whole, than gas illumination—and my own feeling is, that there is no better channel through which to get direct results, than descriptive articles, such as Mr. Luther refers to, designed to interest different trades in gas illumination as applied to their particular business.

I am not prepared to agree with Mr. Luther fully in his belief that gas company officials and managers generally regard the lighting business as one of their most important branches. No doubt every well-informed manager will agree that it is such, (and most of our managers are well informed)—but there are still some who fail to realize just how important their lighting business is, and it cannot be denied that there are many who fail to give it as much consideration as is accorded other divisions. Thus, while agreeing fully with Mr. Luther in his own faith in the importance of the gas lighting business, I venture the opinion that this faith is not as generally shared as he thinks. I have heard some very frank admissions from managers, who evidently did not realize the importance of their lighting business. Needless to say, its importance in their situations is becoming less and less as time goes by.

Mr. Luther's description of the organization of the lighting division impresses me particularly. To district the territory and make the men responsible for the business in their districts, compensate them fairly for the business secured and retained, as well as to hold the supervisors responsible for the performance of the men under their charge, and pay them accordingly—seems to me the only logical way to deal with this question, and I have yet to learn of any case where this method was intelligently followed without success. I think we will all agree in the necessity of educating men to become lighting experts, and of providing them with proper data and details necessary for their work. The sale of gas illumination is necessarily the work of a specialist, and his mental and material equipment should be of the best. On the whole, Mr. Luther's paper seems to me to be a concise description of what a successful lighting division should be—or rather, what a lighting division should be in order to be successful—and I think that his experience along these lines qualifies him to speak with authority on the subject. Apparently the paper does not deal specifically with anything but the arc lamp side of the business—and I would like to ask, if this lighting division attempts residential work, or any of the better class of commercial work requiring other units or fixtures than arc lamps.

THE CHAIRMAN: The next subject will be the report of the committee on gas lighting, after which we will open the subject of street lighting.

The Committee on Gas Lighting felt that this was a proper way to treat the subject of street lighting, about which there is so little information in the PROCEEDINGS of the Institute, rather than to attempt to do it by reports.

REPORT OF THE COMMITTEE ON GAS LIGHTING.

Continuing the work outlined in the 1915 report, we have the following results to present for this year:

(1) Intercomparison data from four laboratories, showing

the efficiencies of gas lamps tested in accordance with the conditions specified in the 1915 report. These laboratories were:

Bureau of Standards, Washington.

Physical Laboratory of the United Gas Improvement Co., Philadelphia.

Photometrical Laboratory, Consolidated Gas Co., New York.

Photometrical Laboratory, Peoples Gas Light and Coke Co., Chicago.

The lamps selected for comparison were:

3 No. 618 Welsbach Reflex Units.

3 No. 71306 Welsbach Upright Units.

1 No. 30 Radio Humphrey Arc Unit.

Each type of unit was accompanied by a number of mantles specially selected for uniformity, in order to reduce as far as practicable any differences due to mantles alone.

The tests at each laboratory were made from stored samples of gas readily obtainable from service mains for such storage. Following are the characteristics of each gas:

	Phila.	Washington	New York	Chicago
B. t. u.	674	621	646	655
Specific gravity	0.650	0.600	0.659	0.639
Analysis:				
Illuminants	12.3	9.9	11.8	11.0
CO	23.1	25.2	31.2	24.8
H_2	35.9	36.2	33.0	35.6
CH_4	17.4	22.8	16.3	18.5
C_2H_6	1.2	—	—	0.4
CO_2	4.2	2.2	2.9	2.9
O_2	1.3	0.4	0.5	1.3
N_2	4.6	3.3	4.3	5.5

Each lamp was tested at three pressures, 2-inch, 3-inch and 5-inch water pressure. For each pressure not only was the candle-power read at the consumption indicated by the usual

fitter's adjustment, but at other consumptions slightly higher and slightly lower than this, and curves were plotted by which to determine accurately the consumption and total luminous output when the lamp was operating at maximum efficiency. By means of this data the lamps rating was determined on the basis of lumens per B. t. u. per hour. In effecting this computation correction was applied for the effect of water vapor upon the candle-power of the mantles, and each type of lamp had all its units averaged into the efficiency figure given.

INTERLABORATORY COMPARISON OF LAMP EFFICIENCIES.

		Efficiency (lmns/btu/hr)				Per cent. of Phila.		
Type	Pres.	Phila.	Wash.	N. Y.	Chicago	Wash.	N. Y.	Chicago
No. 618	2	0.330	0.354	0.387	——	107.2	117.2	——
	3	0.333	0.358	0.377	0.381	107.5	113.2	114.5
	5	0.338	0.354	0.351	0.376	104.7	103.8	111.1
No. 71306	2	0.286	0.321	0.365	——	112.2	127.6	——
	3	0.297	0.321	0.370	0.351	108.0	124.6	118.2
	5	0.300	0.329	0.367	0.376	109.7	122.3	125.5
No. 30 Arc	2	0.324	0.350	0.400	——	108.0	123.5	——
	3	0.341	0.385	0.407	0.387	112.8	119.5	113.4
	5	0.354	0.398	0.339	0.377	112.3	95.8	106.5
Averages:								
No. 618	2, 3, 5	0.334	0.355	0.372	0.378	106.2	111.4	112.8
No. 71	2, 3, 5	0.294	0.324	0.367	0.364	110.2	124.8	121.9
No. 30	2, 3, 5	0.340	0.378	0.382	0.382	111.1	112.3	112.3
All	2	0.313	0.342	0.384	——	109.3	122.7	——
All	3	0.324	0.355	0.385	0.373	109.5	118.8	115.4
All	5	0.331	0.360	0.352	0.376	108.8	106.3	114.4
All	2, 3, 5	0.323	0.352	0.374	0.375	109.0	116.8	114.9

The photometers used at Philadelphia and Washington were integrating spheres; at New York a radial photometer, necessitating a number of readings for each mean spherical candle value; and at Chicago the reduction factor between mean spherical and horizontal candle-power was determined and then values based on mean horizontal candle-powers were converted by this factor into mean spherical candles and into lumens.

It will be seen that the difference existing between Philadelphia and Washington remains fairly constant, indicating that it is due to instrumental differences which might be run down. The differences found at New York and Chicago are not so consistent, though both of these in which rotating of mirrors was necessary are found higher than those using spheres.

On the whole the tests did not fulfil the expectation of being able to rate lamps to practically the same efficiency at different laboratories, as the experience at one laboratory had made promising; but on the other hand, deducting a possible difference of 4 per cent. due to mantles, we are encouraged to go ahead with a refinement of the method and try to eliminate outstanding differences.

(2) The reporting on the subject of better ignition with which the Committee was charged is performed through the paper of Mr. T. J. Litle, Jr., at this meeting, in which he shows progress in reducing gas consumption and in increasing the resistance to draughts. It should be remembered, however, that many of the pilot troubles which have been experienced in the past have been due to the presence of condensible vapors in the gas, and that if the pilot consumption is still further reduced, then the necessity for a still cleaner gas is indicated.

(3) Progress has been made in the attempt to determine the characteristics of the ideal gas, and a great deal of valuable data has been accumulated. The work thus far has been chiefly in studying the effect on lamp efficiencies of varying the calorific value of gas. The Committee recognizes the importance of other factors, however, that have not as yet entered into the test, but which in the determination of good characteristics must not be omitted. It is thought inadvisable therefore to publish present results. We are glad to use this opportunity to state that the importance of this question has been recognized by the Bureau of Standards, which is about to begin tests on an extensive scale in its solution.

In addition to the above work previously outlined, the

Committee has collected suggestions during the past year by means of a circular letter which was sent to seventy-five of the most prominent or experienced men in the gas lighting industry. In reply to the query "Will you please send me a statement of what means in your judgment would best promote an increase or betterment in gas lighting, either general or in a specific field?" more than sixty letters were received, varying in length from four lines to four pages. These contained some very forceful criticisms of the industry's neglect of this part of its business, and also many helpful suggestions.

The Committee takes great encouragement from these letters as a whole. They show that the leaders of the business are not asleep as has been charged, nor are they indifferent. They are simply *unorganized* in any *national* sense to meet the onslaught against their light business by an industry which is very *efficiently organized* in a *national* way.

We have roughly classified the underlying thoughts in these replies and here present them in the numerical order of their recurrence:

Classified List of Suggestions for Improvement of Gas Lighting.

1—Maintenance; some thoroughly digested and applicable scheme.
2—Improved fixtures.
3—Publicity.
4—Cleaner gas.
5—Increased convenience in the control of lights.
6—Better salesmanship.
7—Better ignition.
8—Faith and optimism in gas lighting.
9—A closer contact and influence with architects.
10—Change to calorific standard.
11—Improved glassware and accessories.
12—Special department for gas lighting.
13—Liberal installation terms.
14—Lighting campaigns.
15—The collection and dissemination of authoritative data with regard to the virtues of gas lighting.
16—Stop discoloration.

17—The piping of old houses.
18—Increase in street lighting.
19—Increase in mantle efficiency.
20—School for lighting men.
21—Classify and standardize lighting.
22—Co-operation with fixture dealers.
23—Co-operation with fixture manufacturers.
24—Remove the discrimination against gas lighting in rates.
25—The adoption of a slogan for gas lighting.
26—Increasing the use of portable lamps.
27—Banish open flames.
28—Get the business of isolated plants.
29—Additional outlets in bathrooms.
30—Abolish the point system.
31—Adopt higher gas pressures in house service.
32—Provide tougher mantles.
33—Develop a flat rate meter.
34—Separate combination companies acting as gas and electric.

FIG. 1.

Spread in this way before the convention they should supply topics fruitful for present discussion and for future planning. They are too numerous to be individually discussed by the Committee in its Report, and hence we have decided to treat the whole subject of gas lighting in a chronological order for the purpose of clarifying it. So treating it, the first subdivision is

Gas.

There must be a more specific statement of what is an acceptable gas for illumination purposes by incandescent mantle lamps, not only as regards its approximate composition, calorific value and cleanliness, but as to the capacity of the distribution service to deliver and maintain the required pressure.

Gas as the *fuel item* in gas lighting is a part on which standardization should without delay be started and practised. *Considered as an industry of national scope all other forms of lighting have a more standardized fuel than have we.*

One of the suggestions contributed stated the belief that the principal factor in promoting an increase or betterment of our

illumination would be by the distribution of a gas as nearly as possible ideal (such a gas probably not at present realizable), but to contain absolutely no sulphur, no carbonic acid, having less than 1 per cent. of nitrogen, with only sufficient hydrocarbons to give from 8 to 12 candle-power by flame test, to have a heating value lying between 500 and 600 B. t. u. (the best value to be a question of determination by proper experiment), with allowable variation in such value reduced to a minimum; the gas to be distributed as far as possible at a uniform pressure. This is, of course, an expression of personal opinion, but it indicates what an important subject the Committee has listed as Part I in gas lighting.

(2) In the order of development the next item is that of house piping and fixtures to which might be added accessories. House piping is at present with progressive companies well planned and executed so far as capacity and safety are concerned. Furthermore, Committees of this Institute are preparing recommendations with regard to the location of outlets in rooms and baseboards. They should also take into account the enlargement and rearrangement of piping in old buildings in order to bring them up to the standard adopted.

The subject of fixtures is not so simple, as the fixtures together with the accessories constitute the elastic part of lighting equipment, through which, by placement and utilization shall be met the varied illumination requirements. There is room, however, in the design and installation of fixtures for a marked improvement as to exact alignment and rigidity. We are of the opinion that to no small extent is the depreciation of lighting service, particularly of mantles on burners with by-passes and chain-pulls, due to the instability of fixtures. It is interesting to note that during the past year there has been a re-awakening of interest on the subject of gas fixtures. This has been evidenced particularly in the Pennsylvania Gas Association, where a lighting fixture committee (Mr. W. A. Morris, Chairman) was appointed. This committee has dissected mercilessly some of the chief troubles with gas lighting as found in their state and it is recommended to the members

of the Institute that they familiarize themselves with the contents of the report of that committee. Stating in part its conclusions, I quote as follows:

> "It is the unanimous opinion of your committee that the reason that gas lighting is so generally used to-day is due more to the superiority of gas as an illuminant than to the efforts to obtain and hold this business by those who are interested in the increased sale of gas. * * * The gas industry needs to-day greater co-operation among the men who are supposed to be carrying on the responsibility for the present as well as for the future welfare of the gas business, and this applies particularly to gas lighting. * * * A few progressive companies can at best make a very feeble showing, whereas greater activity by all will create greater interest and will have an inspiring effect upon our consumers. * * * It now seems that we have at our disposal lighting appliances that are second to none and for the time being we should halt in turning out new designs and our efforts as well as those of the manufacturers should be on the lines of standardizing those appliances. * * * The continual introducing of new (lighting) appliances each year that are very little if any better than the old and attempting to re-sell each year new burners to our consumers has assisted very materially in discouraging the use of gas for lighting. * * * The standardizing of lighting equipment at this time would be the means of saving large sums of money, both to the gas companies and to their consumers, and when this is brought about the faith of the public in gas lighting will be greatly strengthened, for they will know that they are not to be put to considerable expense each year for new and so-called improved burners, and in the end the work of maintaining lamps will be greatly facilitated. * * * The stock for repairs of the various lamps will not be nearly so great and we will be selling new burners to many consumers once in a few years instead of to a few consumers every year as we are now doing."

At the recent exhibit held in connection with the Illuminating Engineering Society at the University of Pennsylvania a booth showing combination gas and electric fixtures was displayed. A picture of this booth is shown herewith, Fig. 2, demonstrating the possibility of successfully producing such fixtures without any obvious difference in the treatment for either gas or electric service. Fig. 3 shows these same fix-

tures in detail. The committee does not go on record as favoring combination fixtures, as that is a question still under discussion and about which strong differences of opinion exist, depending upon local conditions.

FIG. 2.

Other figures, Figs. 4, 5, 6, here shown, namely, those of the installation of gas lighting in a cathedral in the City of Philadelphia, demonstrate that gas lighting is adaptable to a wide range of uses with complete success.

(3) Light Unit: By "light unit" the committee means simply the combined burner and mantle producing light, together with ignition, as distinguished from the fixture which supports it and the accessories which utilize its light. It is under this item that the most urgent need for standardization exists. A standardization should bring together burner and mantle man-

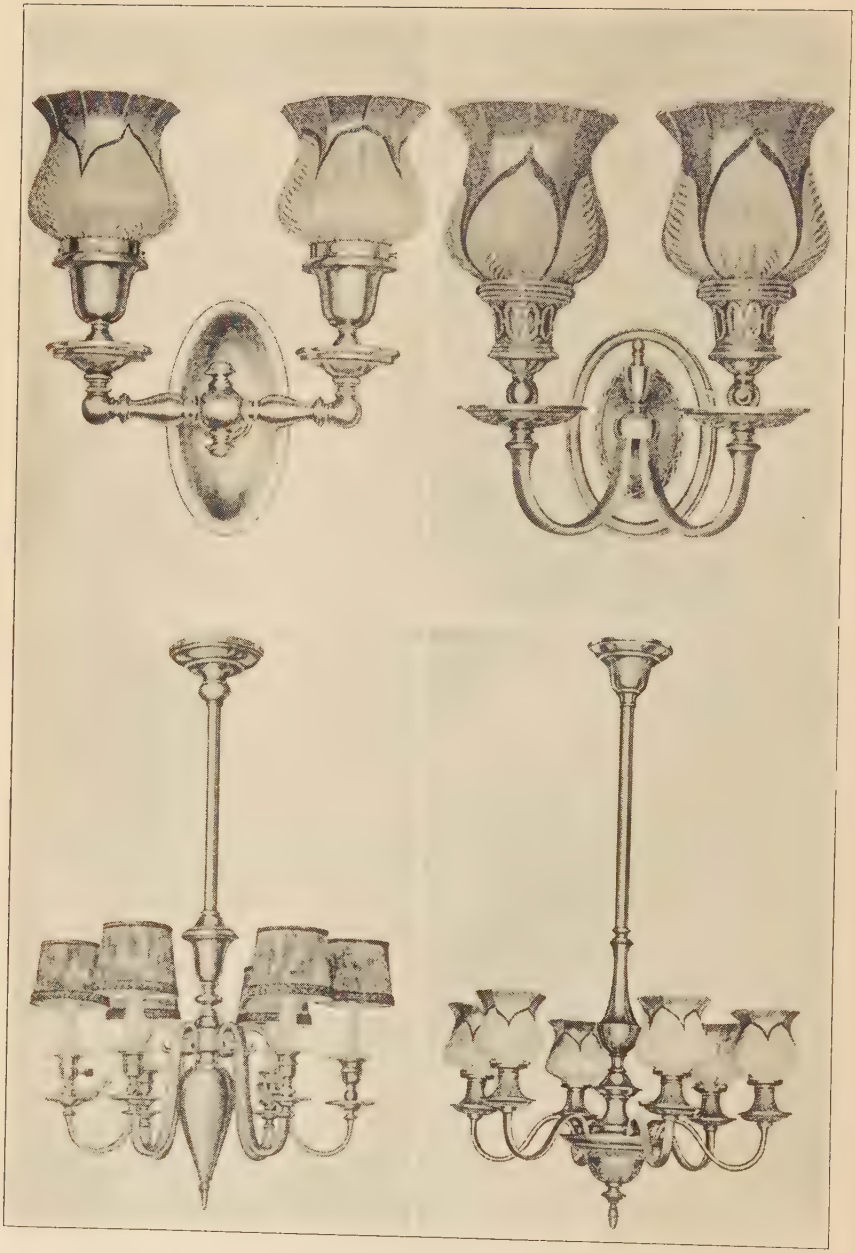


FIG. 3.

FIG. 4.—Gas fixture designed to conform to the interior decorations.

FIG. 5.—View illustrating objectionable glare from outline lighting.

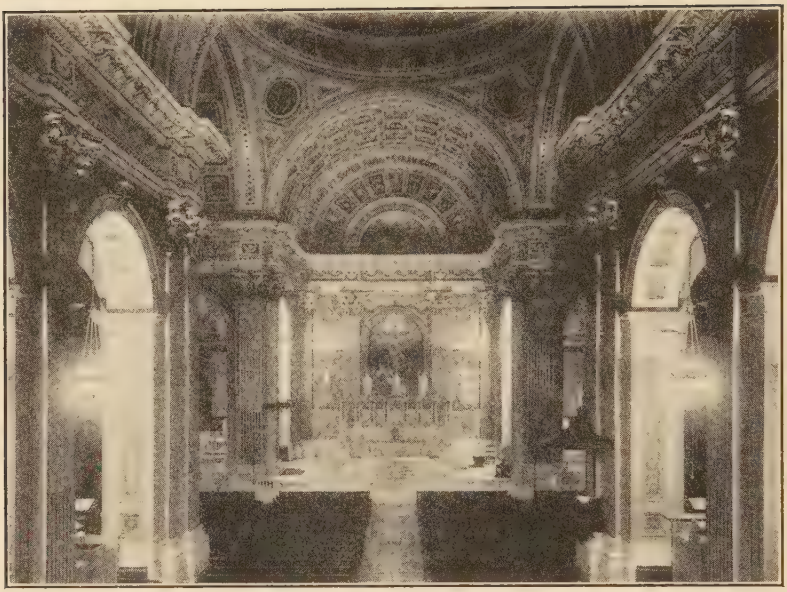


FIG. 6.—Illustrating the diffusion obtained by the improved method of installation.

ufacturers to the making of common authentic types. These units should be of standard sizes and should be named in accordance with their luminous output, each specified as a unit of so many lumens. We need at present a unit of still smaller size than those now on the market. Such standardization is a matter for a committee composed jointly from operators and lamp manufacturers to decide upon, but it is suggested that lighting units might well conform roughly in size to the following scale:

One hundred lumen, 200 lumen, 400 lumen, 600 lumen, 1,000 lumen, and such multiples of those as would work into required lamps and fixtures. Once having the gas units standardized and of uniform manufacture there would still be left the necessary elasticity in meeting lighting demands through the adapting of specially designed fixtures, glassware and other accessories to those units. That the securing of uni-

formity in gas lighting units is not an idle dream, is proved by the following tests:

Twenty-five upright mantles from a batch made to uniformity were selected and tested with a stored sample of gas, on an upright burner, the total luminous flux being observed for each of three different rates of gas consumption. These results are shown in Figs. 7, 8 and 9.

VARIATION IN EFFICIENCY OF WELSBACH NO. 71 UPRIGHT MANTLES.

No.	M. s. cp.	Corr. cons.	M. s. cp. per cu. ft.	Lumens B.t.u.	Per cent. difference from maximum	Per cent. from mean
1	66.2	4.41	15.01	0.285	—12.3	—3.4
2	69.3	4.50	15.40	0.292	—10.1	—1.0
3	70.0	4.41	15.87	0.301	—7.4	+2.0
4	73.4	4.41	16.65	0.315	3.1	+6.8
5	66.6	4.41	15.10	0.286	12.0	—3.1
6	74.0	4.50	16.45	0.312	4.0	+5.8
7	71.1	4.42	16.09	0.305	6.2	+3.4
8	67.0	4.42	15.15	0.288	11.4	—2.4
9	67.4	4.50	14.98	0.284	12.6	—3.7
10	77.2	4.50	17.15	0.325	0.0	+10.2
11	66.1	4.50	14.70	0.278	14.4	—5.8
12	72.5	4.50	16.12	0.305	6.2	+3.4
13	65.7	4.50	14.60	0.277	14.8	—6.1
14	71.2	4.50	15.83	0.300	7.7	+1.7
15	72.1	4.42	16.31	0.309	4.9	+4.7
16	62.1	4.40	14.12	0.268	17.5	—9.1
17	69.4	4.40	15.77	0.299	8.0	+1.4
18	71.9	4.40	16.35	0.309	4.9	+4.7
19	69.6	4.42	15.75	0.298	8.3	+1.0
20	64.9	4.41	14.72	0.279	14.1	—5.4
21	64.5	4.42	14.60	0.276	15.1	—6.4
22	67.0	4.40	15.23	0.288	11.4	—2.4
23	74.5	4.42	16.85	0.319	1.8	+8.1
24	67.0	4.41	15.20	0.288	11.4	—2.4
Average	69.2	4.44	15.59	0.295	9.1	4.3

FIG. 7.

You will notice that the percentage variation from the mean value was 2.3, 2.6 and 4.3 only. With a similar test using

inverted mantles, Figs. 10, 11, 12, the average variations from the mean were 2.0, 2.4 and 3.1 per cent. These figures prove that the plan of standardizing gas-lighting units is entirely feasible.

VARIATION IN EFFICIENCY OF WELSBACH No. 71 UPRIGHT MANTLES.

No.	M. s. cp.	Corr. cons.	M. s. cp. Per cu. ft.	Lumens B.t.u.	Per cent. difference from maximum	Per cent. from mean
1	75.2	4.86	15.47	0.293	—10.4	—3.0
2	78.2	4.83	16.19	0.307	+6.1	+1.6
3	77.7	4.83	16.09	0.305	6.7	+1.0
4	80.9	4.83	16.75	0.318	2.8	+5.3
5	74.3	4.83	15.38	0.292	10.7	—3.3
6	79.0	4.83	16.35	0.310	5.2	+2.6
7	79.5	4.87	16.32	0.309	5.5	+2.3
8	76.1	4.87	15.62	0.296	9.5	—2.0
9	75.6	4.83	15.64	0.297	9.2	—1.6
10	84.2	4.87	17.29	0.327	0.0	+8.3
11	78.8	4.83	16.38	0.309	5.5	+2.3
12	76.3	4.83	15.80	0.300	8.3	—0.6
13	75.2	4.83	15.55	0.295	9.8	—2.3
14	76.2	4.83	15.77	0.299	8.5	—1.0
15	79.7	4.87	16.37	0.310	5.2	+2.6
16	74.8	4.87	15.36	0.291	11.0	—3.6
17	74.8	4.84	15.45	0.293	10.4	—3.0
18	80.8	4.86	16.63	0.315	3.7	+4.3
19	76.5	4.87	15.70	0.298	8.9	—1.3
20	72.5	4.84	14.98	0.284	13.2	—6.0
21	74.6	4.87	15.32	0.290	11.3	—4.0
22	77.8	4.84	16.08	0.305	6.7	+1.0
23	79.1	4.87	16.24	0.308	5.8	+2.0
24	77.9	4.86	16.03	0.304	7.0	+0.7
Average	77.4	4.85	15.94	0.302	—7.6	2.7

FIG. 8.

Having discussed under heading (1) the Fuel, under heading (2) the delivery of it, and under heading (3) the converting of it into light for use, there is left for consideration (4) the human element which enters into the production of good gas lighting.

VARIATION IN EFFICIENCY OF WELSBACH NO. 71 UPRIGHT MANTLES.

No.	M. s. cp.	Corr. cons.	M. s. cp. Per cu. ft.	Lumens B.t.u.	Per cent. difference from maximum	Per cent. from mean
1	91.9	5.50	16.70	0.317	—4.8	+1.9
2	88.9	5.47	16.25	0.308	7.5	—1.0
3	85.0	5.46	15.56	0.295	11.4	—5.1
4	87.5	5.46	16.02	0.303	9.0	—2.6
5	88.1	5.50	16.02	0.304	8.6	—2.2
6	94.0	5.46	17.22	0.326	2.1	+4.8
7	95.0	5.54	17.15	0.325	2.4	+4.5
8	92.8	5.52	16.81	0.318	4.5	+2.3
9	88.7	5.47	16.22	0.308	7.5	—1.0
10	83.4	5.47	15.24	0.289	13.2	—7.1
11	95.9	5.46	17.55	0.333	0.0	+7.1
12	87.2	5.47	15.93	0.302	9.3	—2.9
13	88.9	5.47	16.25	0.308	7.5	—1.0
14	89.8	5.47	16.42	0.311	6.6	0.0
15	92.3	5.54	16.66	0.316	5.1	+1.6
16	91.5	5.50	16.63	0.315	5.4	+1.3
17	90.2	5.52	16.34	0.310	6.9	—0.3
18	89.3	5.52	16.17	0.306	8.1	—1.6
19	91.1	5.54	16.43	0.312	6.3	+0.3
20	87.5	5.50	15.90	0.302	9.3	—2.9
21	88.2	5.52	15.98	0.303	9.0	—2.6
22	92.4	5.52	16.74	0.317	4.8	+1.9
23	96.1	5.55	17.31	0.328	1.5	+5.5
24	90.0	5.50	16.37	0.310	6.9	—0.3
Average	90.2	5.50	16.40	0.311	—6.6	2.6

FIG. 9.

This human element is necessary in at least three steps of the process; first, in the sale, second in the installation and third in the maintenance. While it is true that the same man can perform all three functions, it is likewise true that with large companies where a vast amount of work must be handled and specialization is required, these three duties are very likely to be performed by three separate men, not always collaborating with a sympathetic understanding of each other's work. A salesman might, for instance, convince me that I need a pair of spectacles, but he should be more than a salesman be-

fore he tries to fit me with them. This should be true of a new lighting installation or of an improvement in an old one. The thing desired on the part of the consumer in a satisfactory installation is that he shall be given illumination adapted to his needs in quantity and timeliness and visual comfort. The

VARIATION IN EFFICIENCY OF WELSBACH REFLEX MANTLES.

No.	M. s. cp.	Corr. cons.	M. s. cp. Per cu. ft.	Lumens B.t.u.	Per cent. difference from maximum	Per cent. from mean
1	59.1	3.54	16.70	0.310	—9.6	—5.4
2	64.2	3.58	17.93	0.334	2.6	+1.9
3	—	—	—	—	—	—
4	62.8	3.58	17.55	0.327	4.7	—0.3
5	62.1	3.54	17.55	0.326	5.0	—0.6
6	64.3	3.58	17.95	0.334	2.6	+1.9
7	62.4	3.58	17.43	0.324	5.5	—1.2
8	62.3	3.52	17.70	0.329	4.0	+0.3
9	64.1	3.58	17.90	0.333	2.9	+1.5
10	59.3	3.56	16.65	0.310	9.6	—5.4
11	66.0	3.58	18.44	0.343	0.0	+4.7
12	61.8	3.54	17.45	0.325	5.2	—0.9
13	63.0	3.54	17.80	0.331	3.5	+0.9
14	64.6	3.52	18.35	0.341	0.5	+4.0
15	63.5	3.54	17.94	0.334	2.6	+1.8
16	62.6	3.58	17.48	0.325	5.2	—0.9
17	65.2	3.57	18.27	0.340	0.9	+3.7
18	65.3	3.57	18.29	0.340	0.9	+3.7
19	59.7	3.58	16.67	0.310	9.6	—5.4
20	63.1	3.58	17.62	0.328	4.4	0.0
21	—	—	—	—	—	—
22	62.7	3.55	17.67	0.329	4.1	+0.3
23	59.5	3.54	16.80	0.313	8.7	—4.6
24	64.0	3.54	18.08	0.336	2.0	+2.5
Average	62.8	3.56	17.64	0.328	4.4	2.4

FIG. 10.

thing that is desired on the part of the gas company is that the installation once made shall remain fairly permanent and be continued in use. There can be no doubt that some of the lighting campaigns which have been perpetrated resulted in a

loss of prestige to gas lighting in a percentage of cases, from the fact that sales of lamps so made are frequently ill advised, have not remained permanent and have resulted in dissatisfaction on the part of the consumer where little or none before existed. So likewise many a good sale has been bungled on installation through the poor workmanship or manners of those charged with it.

VARIATION IN EFFICIENCY OF WELSBACH REFLEX MANTLES.

No.	M. s. cp.	Corr. cons.	M. s. cp. Per cu. ft.	Lumens B.t.u.	Per cent. difference from maximum	Per cent. from mean
1	78.1	4.05	19.28	0.359	—1.9	+1.7
2	79.4	4.06	19.55	0.364	—0.6	+3.1
3	78.0	4.04	19.30	0.360	—1.6	+2.0
4	72.3	4.04	17.90	0.333	—9.0	—5.5
5	79.3	4.06	19.52	0.363	—0.9	+2.8
6	77.5	4.05	19.13	0.356	—2.8	+0.8
7	79.9	4.08	19.58	0.364	—0.6	+3.1
8	79.5	4.05	19.62	0.366	—0.0	+3.7
9	77.3	4.06	19.03	0.354	—3.3	+0.2
10	76.5	4.09	18.70	0.348	—5.0	—1.5
11	74.9	4.04	18.54	0.345	—5.6	—2.3
12	78.6	4.06	19.35	0.360	—1.7	+2.0
13	76.7	4.10	18.70	0.349	—4.7	—1.2
14	78.7	4.05	19.44	0.362	—1.1	+2.5
15	76.7	4.10	18.70	0.349	—4.7	—1.2
16	76.9	4.10	18.75	0.349	—4.7	—1.2
17	76.9	4.06	18.95	0.353	—3.6	0.0
18	75.9	4.06	18.70	0.348	—5.0	—1.5
19	74.3	4.10	18.12	0.338	—7.6	—4.3
20	75.9	4.09	18.55	0.346	—5.5	—2.0
21	——	——	——	——	—	—
22	79.8	4.09	19.50	0.363	—0.8	+2.8
23	77.4	4.10	18.88	0.352	—3.8	—0.3
24	76.8	4.05	18.96	0.353	—3.6	0.0
Average	77.3	4.07	19.00	0.353	—3.6	1.5

FIG. 11.

Of the three functions of the human element, however, the one which to-day is strongly before us is that of maintenance.

This is evidenced by its first position on a list of suggestions given earlier in this report. The Committee made an earnest endeavor to secure a paper on the subject of maintenance to be presented at this meeting, but without success. We are familiar by papers read before the gas associations and from

VARIATION IN EFFICIENCY OF WELSBACH REFLEX MANTLES.

No.	M. s. cp.	Corr. cons.	M. s. cp. Per cu. ft.	Lumens B.t.u.	Per cent. difference from maximum	Per cent. from mean
1	80.2	4.48	17.90	0.333	3.1	+3.5
2	81.2	4.46	18.20	0.339	2.4	+5.3
3	79.7	4.50	17.70	0.330	4.0	+2.5
4	73.0	4.48	16.30	0.303	11.9	—5.8
5	80.1	4.46	17.95	0.334	2.8	+3.7
6	73.8	4.48	16.47	0.307	10.7	—4.8
7	81.7	4.42	18.48	0.344	—0.0	+6.9
8	78.1	4.46	17.51	0.326	5.1	+1.2
9	76.5	4.46	17.15	0.319	7.1	—1.0
10	78.3	4.48	17.48	0.325	5.4	+0.9
11	76.1	4.46	17.06	0.318	7.4	—1.3
12	81.2	4.48	18.12	0.337	2.0	+4.7
13	76.9	4.48	17.16	0.319	7.1	—1.0
14	74.0	4.46	16.60	0.309	10.1	—4.1
15	78.1	4.48	17.43	0.324	5.7	+0.6
16	76.9	4.46	17.24	0.321	6.5	—0.3
17	78.8	4.51	17.46	0.325	5.4	+0.9
18	75.3	4.47	16.85	0.313	8.9	—2.9
19	74.0	4.46	16.59	0.309	10.1	—4.1
20	74.1	4.46	16.61	0.309	10.1	—4.1
21	—	—	—	—	—	—
22	81.2	4.46	18.20	0.339	2.4	+5.3
23	75.7	4.46	16.97	0.316	8.0	—1.9
24	73.9	4.46	16.57	0.308	10.4	—4.5
Average	77.3	4.47	17.30	0.322	6.3	3.1

FIG. 12.

articles in the technical press with schemes of maintenance that have been tried. One of the most promising ones, the Toronto plan, is about to receive a larger trying out. None of them are without defects. We must recognize, however,

in the face of the present widespread and splendidly organized selling service by our competitors that the holding of the present gas lighting must be accomplished by keeping our units in good condition. The committee takes this opportunity to propound three questions relating to maintenance, and to invite candid discussions on them.

THREE MAINTENANCE QUESTIONS.

(A) In seeking successful maintenance what is your goal? If we seek perfect maintenance it will be accomplished only when at any moment desired a consumer may push a button, pull a by-pass or apply a match and secure an illumination which has been satisfactorily planned and which repeats each time upon demand. This will require perfect devices which do not get out of order, either through wearing of their own parts or through the deleterious matter which comes from the fuel supplied to them. At this point it would be worth while to analyze the various defects which require the visit of a maintenance man. We find that loss of service may be classified in a practical way under the following heads:

Pilot out.
Carboning of mantle.
Under-adjustment of mantle.
Broken mantle.
Broken glassware.

It would be a most valuable piece of work to compile these five troubles in any city for a year and to trace back in each case the causes for these troubles and find the remedy to be applied, and by this means to have satisfactorily placed before us not only the percentage of maintenance calls rendered necessary from each cause but the reduction in maintenance cost of each item when it has been eliminated as far as presently feasible.

Pilot outages classified as above are not intended to refer to those which are blown out by drafts, but even these may be largely reduced by care in installing a lamp, having a care to

obtain protection of the pilot from the direction from which the draft may come. Pilot outages as classified here are really internal pilot stoppages, due to tarry or condensible products in the gas, or to a "cracking" of the hydrocarbons by overheating.

Carboning of mantles results from a decrease in the proportion of primary air. It is usually traceable either to a change in gas pressure or the gas composition, since the air characteristics remain fixed, except where air carries dust or lint and clogs the primary supply.

An under-adjusted lamp is in danger of a flash back. It is usually due to lowered gas consumption chargeable to pressure loss, gravity rise or interior stoppage.

Of broken mantles and broken glassware no small percentage also is traceable to pressure fluctuations which have resulted in lengthened pilot flames, causing impingement of the flame on the glassware, or too strongly on mantles, with consequent breakage.

It can thus be seen that a very large percentage of our present maintenance cost could be obviated by a properly constituted and uniform gas delivery at a uniform proper pressure. Beyond such cause would come the accidental breakage of mantles and occasionally of glassware from external reasons, together with a natural deterioration of the mantle with time.

It is apparent, therefore, that the perfect maintenance we are considering as a goal can never be reached through periodic visits alone. A maintenance visit may have been completed at 6 o'clock, the illumination is required at 7, an accidental breakage of the mantle has occurred in the interval, and so far as the maintenance man is concerned, he will not give service on the injured lamp that night. Our best efforts at maintenance, therefore, must be supplemented by education, and right at this point the whole maintenance problem requires treatment from the historical standpoint.

Seventy years ago the average house was illuminated by oil lamps. At that time they were smelly, greasy, dangerous, troublesome to clean and operate, and yet this maintenance

was cared for in each home by its inmates. The gas industry came into the field, supplied these homes with open-flame burners, after which a preliminary trial were gratefully received because of the reduction of *daily* work which they required. It is to be remembered, however, that these burners used various kinds of glassware and that the *periodic* cleaning and maintenance of this glassware was still performed in the house. Then came the era of incandescent gas lighting and we as an industry introduced to the occupants of these houses breathlessly an inapproachable mystery! We explained the difficulty of handling the lamps and of adjusting them, the great care that must be exercised; we said, "Sh, if it acts up send for an expert, but don't touch it." We have continued practically to encourage this policy down to the present time with the result that the only continuous inmate of the house formerly engaged in maintenance, namely, the woman, has been frightened away from any attempt to maintain the incandescent gas lighting units. This is our present condition, which spells the need for further education and it is directly to the solution of this educational problem that we must apply ourselves in supplementing any scheme of maintenance which we advocate if we shall wish to have perfect gas lighting service. We have spoken more particularly of homes because the residence problem is the one which is now uppermost.

(B) How are we to measure maintenance? How many gentlemen here to-day ever tried to? The thing we are delivering is illumination service; the way to measure illumination is by an illuminometer. There are no towns to our knowledge which are engaged in measuring the depreciation of their lighting service in practice by illuminometers. We have no data except some tentative data which has been accumulated by this committee in the past year, and which goes to prove that the mere fact of a lamp being on maintenance does not mean that it is giving good illumination. It is true the number of places selected for the test was only forty, but we found places not on maintenance giving as good service as some of those which were on maintenance. The

results secured, tabulated, and with curves drawn, are not sufficient in number to warrant their publication as a part of a committee report, but they are sufficient to prove the desirability of extending this means of investigation to every large city in order that its gas company may acquaint itself with the cost of maintenance based upon the improved results obtained over installations which have no maintenance.

Another service of the illuminometer has been in proving that sudden variations in gas pressure of $^{5}/_{10}$ of an inch or slow variations in pressure of 1 inch are sufficient to cause noticeable changes in illumination, and thus to open the way for discontent on the part of the consumer. This too, is part of good lighting service.

(C) How this perfect maintenance or an approach towards it shall be accomplished is one of the questions which is up for discussion at this time, and we urge those who are best advised to give us the benefit of their experience or their suggestions. Would it not seem reasonable to suppose that any such plan of combined maintenance and education of the consumer as suggested would bring a gradual reversal in the percentage of service rendered by each in producing good lighting and that as the consumer became more and more competent to take care of the lamps the company's expense on maintenance would diminish?

(Applause.)

CHAS. O. BOND, *Chairman*,
J. E. BULLARD,
R. B. HARPER,
ARTHUR HEWITT,
NORMAN MACBETH,
THOMAS SCOFIELD,
C. H. STONE,
BUREAU OF STANDARDS.

MR. R. M. KELLOGG (Mt. Vernon, N. Y.): (Written discussion communicated.) The enclosed galley proof of the report of the Committee on Gas Lighting, was handed to me

by Mr. C. H. Stone, of Middletown, N. Y., with the request that I look it over with a view to making minor corrections and commenting on such parts as were interesting to me. I have made a few small changes but have very little criticism on the report as a whole.

It seems to me that "maintenance" is one of the vital factors if we are to retain our lighting business or to extend it. Your report contains the following:

"We are familiar by papers read before the gas associations and from articles in the technical press with schemes of maintenance that have been tried. One of the most promising ones, the Toronto plan is about to receive a larger trying out."

I was not altogether favorably impressed by the success of the Toronto plan, for while some degree of success was obtained, in that the maintenance did bring up, to a certain degree of efficiency, the appliances in general, I understand that the Company found it rather an expensive proposition and also that there was a certain lack of organization connected with the administration of the plan. I do not see how the Committee can, if it has knowledge of a plan of maintenance as carried on by several New England companies, hold the decision that the Toronto plan is the best or one of the best. I enclose a copy of the paper presented at the last meeting of the New England Association of Gas Engineers, which describes, at length, the plan I have in mind. Briefly, real maintenance is obtained and at no cost to the company.

The best reason for the success of an outsider in this field seems to be that he is obliged to make a "go" of it in order to derive any profit for himself. Gas companies attempting such work themselves, do not have this incentive to spur them on and it is usually the case that after a short time, maintenance schemes, carried on by the companies themselves, have gradually failed in obtaining the desired result.

Mr. Charles A. Luther (Chicago): (A.) To be successful in the maintenance of mantle lights, both from the standpoint of the consumer and the company supplying the main-

tenance service, there are several things of primary importance to consider.

To satisfy the consumers that mantle lighting is as dependable, if not more so, than other sources of illumination, we must remove all doubts from the consumer's mind that the mantles are not as fragile as they imagine them to be, and that the units can be adjusted or regulated easily by anyone after they have been instructed in their operation. The average person is only too ready to absorb any additional knowledge that may be imparted to them by the maintenance men.

As the consumers are but natural, and will not become interested in anything that is not considered by them as essential to know, we, as gas men, must present the subject in such a light that they will consider the up-keep of their mantle lights as important to know, as the up-keep of their other household utilities. To do this:

1st. All consumers should be induced to have their mantle lights maintained periodically by the gas company at a nominal cost per unit per month. The average residential lights should be inspected once a month, and for such installations where the units are used considerably, they should be inspected more often, either semi-monthly or weekly.

2nd. See that all their maintenance men are thoroughly educated in the operation, adjustment and up-keep of all kinds of mantle units, and that they are thoroughly capable of imparting their knowledge to others in a comprehensible manner.

3rd. Not only all the maintenance men, but all the employees of the gas company must from time to time, receive instructions in the maintenance of mantle lights, so they will be in a position to act as an educational mouth-piece of their company when necessity might arise for them to inform someone, possibly their next door neighbor, how some defect in their lighting equipment should be fixed.

The maintenance men must thoroughly educate the users of mantle lights, while on their periodical visits, so that if necessary the consumer will know how to adjust and equip their

lighting units, or in other words, tell them what to do in case of emergency.

4th. Every gas company should have maintenance men that could be sent out on special calls, and the consumers should be notified of this fact.

In Chicago we are maintaining over 120,000 small lights at the present time and the percentage of special calls are so small it is not worth mentioning.

Imagine the amount of educational work that could be done along this line if all the employees of gas companies down to the office boy were thoroughly instructed in mantle lights so they could educate their family, and they in turn would pass it along to their friends, an endless chain would be constructed so that in time there would be no excuse for practically everyone to know that mantle lights could be equipped and adjusted by the users of same.

(B.) There is only one practicable application of the illuminometer in maintenance work, in my estimation, and that is, to demonstrate to the maintenance men, that the proper adjustment as well as the proper cleaning of the glassware and parts, has such a great influence on the efficiency of the units.

The maintenance men should be requested to attend classes where the operation of the illuminometer can be shown to them, and each man be instructed in the use of same, after which it can be clearly pointed out to them what it means to the consumer to have their units maintained by the gas company and why the maintenance men should adjust the mantle units to their highest efficiency.

(C.) The most rapid approach towards perfect maintenance can be made by first, educating or convincing ourselves that the up-keep of mantle lights is not as complex as a good many gas men believe they are. Second, after convincing ourselves, convince our maintenance men and gas employees and then let them convince the consumers.

STREET LIGHTING.

THE CHAIRMAN:

Gentlemen, a member of this Institute should be able, on consulting the PROCEEDINGS of his society representing the accumulated work of 10 years, to find treated in some form, by paper or discussion, almost any phase of the gas industry in which he may be interested. To expedite such reference a new index covering the 10 years has just been issued. Using that index it will be found that aside from a technical paper on methods of distance control which are applicable to any form of lamp, that the subject of "Street Lighting" has received *one page* in a year's review of progress in the business, and that of the one page just nine lines refer in very general terms to American practice.

If one is fortunate enough to possess a copy of the *Proceedings of the International Gas Congress* held at San Francisco in 1915 he will find an excellent article on "Street Lighting," and I counsel all of you to provide yourselves with that volume before its edition is exhausted.

It is evident that this subject has been seriously neglected in our discussions, and therefore probably in our thoughts.

We often hear criticism of gas lighting for interiors, based on excessive heat, discoloration, odors, products of combustion, liability to accident, etc. If any of us really subscribe to these objections, (and from the lack of spirit in pushing gas lighting many seem so to do) then how criminal indeed are we to permit the retention of gas in the small home, where of all places these evils would be most magnified. *The very argument* drives us *out doors* for *business,* even if we do not otherwise see the advantages of going willingly; and there are such advantages!

Street lighting is a large consumer; it consumes from many services instead of one it is true. But it takes gas in equal bits from many points and does not intermittently overload the main with consequent bad pressure service. It eliminates meter and several other charges. More than all, if well done it continuously advertises. Of two large consumers which is

best, the one who gets satisfaction and keeps it to himself, or the one who in getting satisfaction is making it continuously apparent to all observers?

The first of these is after all an individual; your service to him is in the nature of *private service.* But *street lighting* is of all forms of our business the best index of our *public service,* and it is our pride that we are engaged in public service.

The object of throwing this subject open for discussion today is to find out what the experiences have been in the various towns in street lighting, to see whether there is not something encouraging for gas lighting as a rule in those experiences. In this regard I would like to ask Mr. von Maur if he has not something he can tell us about street lighting in St. Louis.

GAS STREET LIGHTING AT ST. LOUIS.

Mr. J. D. von Maur (St. Louis): St. Louis, with a population of approximately 750,000, has 22,242 incandescent gas mantle street lamps lighting exclusively the major portion of the residential district.

The entire area of the city is about 61⅓ square miles, of which approximately two-thirds is gas lighted, representing an average of 544 gas street lamps per square mile.

In addition to the gas lamps there are 3,248 incandescent naphtha mantle lamps lighting the parks and those places to which gas mains have not as yet been extended.

The lighting is divided into practically four classes: regular street, viaduct, traffic signal, and park and alley lighting.

General Street Lighting.

The type of lamp generally employed for the regular street lighting is the Welsbach boulevard unit, equipped with the 60 candle-power single upright mantle burner, clear glass globes and opal domes, usually spaced from 100 to 125 feet apart in the block. At important street intersections two lamps per post are used, and generally there is a post at each of the four corners.

FIG. 1.—Boulevard Lamp; Corner Unit

FIG. 2.- Cluster Unit—Nine Lamps; Lindell Boulevard and McPherson Avenue.

Fig. 1 shows this type of lamp and post fitting, the names of the intersecting streets appearing in red letters on ground glass segments, supported by the crown of the lamp, and are plainly legible day and night.

For effective lighting in open places, between wide intersections, cluster posts of ornate design, as shown in Figs. 2, 3 and 4 are used, carrying from nine to thirteen boulevard lamps.

Viaduct Lighting.

St. Louis has a great many viaducts, designed by the City Bridge Department, which are examples of the best types of engineering construction.

Owing to the heavy traffic on these viaducts, the plans include the provisions for necessary lighting, involving the design of lamps and standards to be in keeping with the architectural features.

Fig. 5 shows the style and arrangement of the lighting units on Kingshighway Viaduct, one of the finest in the city; the details of post and lamp design are seen in Fig. 6, which is one of the two cluster posts at each approach to the viaduct.

The posts and lamps are constructed of cast iron and bronze. The globes are of semi-diffusive, alba glass, each enclosing a double inverted mantle unit of 120 candle-power. The domes are of cast bronze and consequently opaque.

Another example of viaduct lighting is shown in Figs. 7 and 8, the Compton Viaduct, where another style of lamp and standard is used. The spherical globes on these lamps are of diffusive, monax glassware, surmounted by a copper ventilator. These, as well as all the other viaduct lamps, are equipped with 120 candle-power, double inverted gas mantle fixtures.

The latest type of upright, standard, viaduct lamps is shown in Figs. 9 and 10 of the Union Boulevard Viaduct. These lamps are a modification of those used on the Kingshighway Viaduct, but are better adapted for gas lighting and possessing in addition illuminated paneled domes.

FIG. 3.—Cluster Unit—Thirteen Lamps; Kingshighway and Forest Park.

FIG. 4.—Cluster Unit- Thirteen Lamps; Forest Park Entrance and Lindell Boulevard.

FIG. 5.—Kingshighway Viaduct.

FIG. 6.—Kingshighway Viaduct; Cluster Unit.

Fig. 7.—Compton Viaduct.

FIG. 8.—Type "D" Unit, Compton Viaduct.

FIG. 9.—Union Boulevard Viaduct.

FIG. 10.—Type "E" Unit Union Boulevard Viaduct.

FIG. 11.—Tower Grove Viaduct.

FIG. 12.—Bronze Bracket Unit; Tower Grove Viaduct.

Figs. 11 and 12 show the styles of lamps and posts on the Tower Grove Viaduct. This is one of the latest additions to the viaduct system and represented a rather complex problem from an engineering standpoint, in that it had to provide for the elevation of grade of four intersecting streets. On this viaduct overhead transmission lines had to be provided for the electric street railway, telegraph and telephone services. The poles are of reinforced concrete, gradually tapering in cross section toward the top, and with champfered edges, carrying one and two ten pin arms. Inside each post is a 2-inch gas riser pipe, with oblique lateral extensions to the inside of the lamp bracket, where the connection is made to the special form of double inverted mantle fixture.

Owing to the design of the bracket not providing for an adequate ventilator stack, the supporting band of the bracket above the globe was utilized as a ventilator shield by being cast in a special manner. In this way the architect's ideas were made entirely practical for gas lighting, without altering a line in the design. The brackets are of cast bronze and present a very attractive appearance on the light colored concrete posts.

The mounting height of these lamps is such as to bring the center of the 18-inch alba globes about 16 feet above the street surface. The distribution of light by this unit is remarkably efficient and beautiful, especially when one considers that it contains a fixture of only 120 candle-power.

At the present time only one-half of the total number of units have been installed, but as soon as the necessary funds are available the city will have each post fitted in a similar manner.

It is of considerable interest no doubt, to be able to report that gas lighting has been entirely satisfactory on all these viaducts, the service being highly appreciated by everyone. Since the first installation of the various types of units shown several years ago, the outage has been nil.

Traffic Signal Lighting.

The rapid increase of automobile traffic in the residential

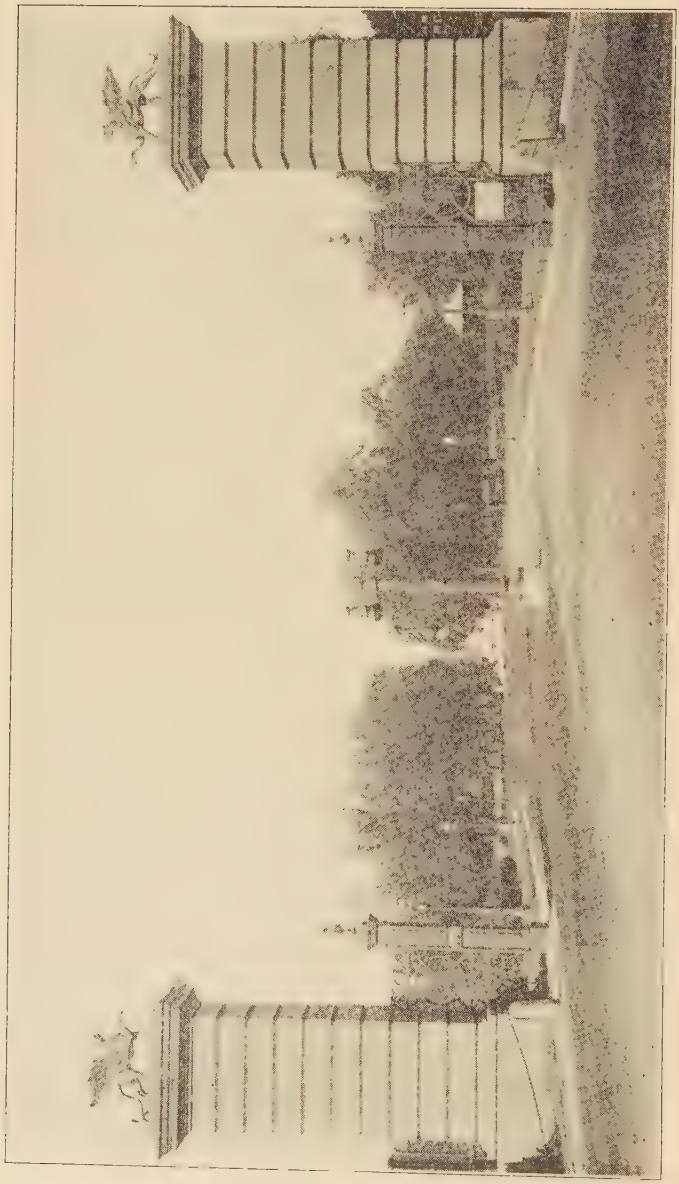


FIG. 13. Traffic Signal Unit; Entrance to Tower Grove Park.

streets, requiring special regulation and direction, brought about the design and installation of the traffic signal lamp shown in Fig. 13. This unit comprises a two arm post standard, mounted on an elliptical concrete base, equipped with two pendant lamps, carrying ruby glass globes 12 inches in diameter, etched on the inside and cut off at the bottom to an opening of about 8 inches in diameter. Each lamp is fitted with a single inverted mantle 60 candle-power fixture.

When burning the ruby globe is uniformly and brightly lighted, as well as the street surface for a radius of 10 feet around the post, by reason of the direct light from the cut-away section of the globe, so that not only is the signal seen, but the post and base is also plainly visible. This represents a distinct and unique type for this class of lighting.

Since the introduction of this unit, a total of 35 posts, 70 lamps, have been installed in various parts of the city, to the satisfaction of the authorities, pedestrians and automobilists.

Demonstration Lighting.

Acting on the principle that a higher responsibility is involved in dealing with the city than mere compliance with the exact terms of the street lighting contract, the Laclede Gas Light Company, jointly with the Welsbach Street Lighting Company of America, which furnishes and operates the gas street lighting system, has endeavored to interest the citizens and municipal authorities in the highest form of gas street lighting by making a practical installation of the newer forms of units, without any additional cost to the city. After a preliminary survey, permission was obtained to make these demonstrations on several of the most prominent streets, where the need of greater illumination was felt.

To be in keeping with the esthetic surroundings, the type of standard used was that selected by the St. Louis art jury, as a result of a competitive design contest. This post is shown in Fig. 14, fitted with the same type of lantern as that shown in Fig. 10 on the Union Boulevard viaduct lamps.

FIG. 14. Type "E" Unit; St. Louis Art Standard in front of Racquet Club.

FIG. 15.—Type "D" Unit; St. Louis Art Standard.

It might be mentioned here that the choice of lamp for this viaduct came as a direct result of the operating demonstration of new units made on Lindell Boulevard.

Another type of lamp fitting the accepted post as shown in Fig. 15 is also being used to demonstrate a variety of design.

The enamelled street signs on the post have been highly commended; the diffusive character of the light emitted by the lamp brightly illuminating the sign, so that it is easily read at night.

The general character of the streets selected for the demonstration is shown in Fig. 16 of Lindell Boulevard, the new type "E" lamps being seen on one side of the intersecting street and the regular boulevard lamps on the other.

The total absence of poles and wires, with the one exception painfully evident in the right hand corner, adds to the charm of this beautiful street.

The type "E" units are equipped with totally diffusive, monax glass globes, paneled domes, and triple inverted mantles producing 220 candle-power.

A total of 79 of these lamps are being used in the demonstration, in addition to 60 of the type "D" lamps and 60 regular boulevard lamps, equipped with 120 candle-power fixtures.

While there has been no direct increased revenue returned by the demonstration lamps themselves, a total of 477 mantles being given the city on the basis of 221 mantles paid for in the regular lamps displaced by the newer types for the term of the demonstration, it is significant that since the demonstration was started, less than one year ago, a total of 67 Type "E" lamps have been ordered installed by the City of St. Louis in various sections, in one notable instance around the Jefferson Memorial Building.

In addition to these lamps ordered by the city, 43 of the same type have been placed by contract with private parties and property owners in restricted residential districts.

An example of one of the private installations is shown in Fig. 17 of the five lamps in front of the Kings Theatre, one of the most beautiful and attractive of St. Louis' playhouses.

FIG. 16.—Lindell Boulevard. Type "E" Units; St. Louis Cathedral.

FIG. 17.—Type "E" Units; Kings Theatre. (Private.)

The original owner of this place, happening to see the illuminating effect of the Type "E" units on Lindell Boulevard, asked the gas company to install these units in front of his property under contract, as he felt that they were needed to complete the color lighting effect, notwithstanding the fact that the exterior of the building itself is electrically lighted.

When this theatre changed hands, the contract for the lamps expired, and as the gas company was proceeding to dismantle the lamps, the new owner insisted on retaining them on a term maintenance contract, showing that the original installation was not a mere fancy, but what developed to be a proven necessity.

One of the private streets where Type "E" installations have been made, is shown in Fig. 18, Portland Place, a total of 33 lamps being placed on this street, between Kingshighway and Union Boulevard. In the center of the parked space at the driveway entrance can be seen a double lamp unit of this type which has distinct good architectural features.

No photographs are shown of the lighting effects at night, because it is impossible in such a way to do justice to the beauty and general charm of the illumination produced; it must be seen in order to be thoroughly appreciated.

The effect of the demonstration has been to attract the favorable attention of such bodies as the Civic League and others. We believe that it has done more than any other form of advertising to demonstrate to the general public the desirability and advantages of gas for lighting.

Gas street lighting consumes a very considerable part of our output, and our attitude toward it is evidenced by our willingness to make post and service investments to have it extended. When the best features of gas lighting are brought out in proper equipment and systematically maintained, it is a business which will grow through the general appreciation of its merits.

Furthermore, I wish to say in conclusion that such examples of excellent lighting service as are now shown on Lindell

FIG. 18.—Type "E" Units; Portland Place. (Private.)

Boulevard, Kingshighway, Portland Place and all the gas-lighted viaducts in St. Louis, are enough to keep up any gas man's courage and faith in the illuminating qualities of the product he makes and sells.

Mr. E. B. Myers (Philadelphia): (Written discussion communicated.) This describes the situation in Philadelphia in regard to gas street lighting.

In Philadelphia, in the year 1907, there were 19,000 gas street lamps, all equipped with flat-flame burners, each lamp consuming over 5 cubic feet of gas per hour and giving approximately 23 candle-power. These lamps were scattered over the entire area of the city and were spaced on opposite sides of the street about 100 feet apart.

In 1913 the flat-flame burners on all these lamps were replaced by Welsbach mantle lights, which resulted in a considerable increase in the candle-power and a correspondingly large decrease in the gas consumption. After this time, the new lamps erected were installed on opposite sides of the street about 125 feet apart, whereas the original street lamps equipped with flat-flame burners were spaced about 100 feet apart.

In Philadelphia to-day there are in operation 25,000 gas street lamps, and within the next few months there will be added to this number, 11,000 more lamps, this latter number now being converted over from naphtha to gas. We may say, therefore, that by the end of 1917 the City of Philadelphia will have in operation a total of 36,000 gas street lamps. These street lamps are equipped with single upright Welsbach mantles, enclosed in round, clear glass globes. The lantern is of the standard boulevard type and the post is of the design used generally by the Welsbach Street Lighting Company.

Philadelphia contains 350,000 homes and covers an area of 121 square miles. These 36,000 gas street lamps are contained in an area of 100 square miles, so that there are 360 gas street lamps per square mile of territory served, and one gas lamp for every 10 homes or one gas street lamp for every forty-seven people in Philadelphia.

A comprehensive patrol system, employing approximately 425 men, looks after the lighting, extinguishing and cleaning of the lamps. The glassware is thoroughly washed and cleaned once a week and the lantern frames and posts painted once each year.

Thus, not only are the lamps themselves kept up to a high state of efficiency at all times, but the installation is also ornamental during the daytime. We feel that the excellent condition in which these lamps are kept and the excellent service rendered by our sub-contractor is due in no small measure to the nightly inspections and the nightly candle-power readings taken on the street by our own special force of inspectors.

The Chairman: Is Mr. Riley of Baltimore in the room?

Mr. H. M. Riley (Baltimore): We have, as in all large cities, electric and gas lighting, the latter being handled by an outside company. That is to say, there is a triple contract arrangement, wherein this outside company contracts with the city to maintain the lamps, clean the globes, supply mantles, etc. The gas company in turn bills the city for the gas consumed at a certain definite figure.

Now this brings up a very interesting question, which possibly some of you have not considered, and that is, are you absolutely sure that the company supplying the lamps and maintenance are living up to their contract? In other words, are the mantles durable, do they give good light, are the lamps lighted and extinguished on time, etc.? Certainly if good maintenance is not supplied, gas lighting receives a severe blow and the gas company is the innocent loser. Thus it can be seen that the gas company should maintain an inspection of street lamps on their own account.

In Baltimore there are a certain number of lighting districts, and in each a definite number of lamps, on each and every one of which there is a governor. The company maintaining the lamps formerly installed "Bull" governors, but the tendency is now toward the "English" governor. I have one of each here. In the majority of cases the governors are adjusted to

pass 3 cubic feet per hour, and are simply large governors more or less in miniature.

The outside company sends the governors to our laboratory where the man removes the adjusting or set screws, coats them with a fire cement, replaces the adjusting screws and adjusts the governors to 3 cubic feet per hour. After this the governors are allowed to stand for 24 hours, during which time the cement sets and the screw becomes more or less permanently fixed. Then, in order to test for any looseness, the governors are bumped on a mantle bumping machine for 20 minutes and agitated at the rate of about 275 bumps per minute. A lead seal is then soldered on each governor to prevent tampering with and finally a consumption check is run. I have here a picture of this bumping machine and will just pass it around. (Passing the picture to members.)

We find that after the governors have been bumped, sealed and tested about 15 per cent. of them have lost their adjustment, and in almost all cases of lost adjustment the set screw has worked partly out and the consumption is greater than 3 cubic feet per hour.

These governors have been tested by us from a pressure of 1½ inches up to one of 6 inches and we find they hold for all practical purposes at 3 cubic feet per hour.

We have also tested them on air after adjusting for gas at 3 cubic feet per hour, and find the diminution of capacity checks exactly with Pole's formula. I have here some figures showing the number of gas street lamps in the City of Baltimore in 1881 and in 1915, and I am also going to read to you just exactly how many electric lamps there are. That undoubtedly will interest you.

In 1881 there were 5,346 gas lamps of all styles and 4 electric lamps.

In 1915 there were 11,626 gas lamps and 5,883 electric lamps.

Now I will take just about two more minutes of your time in telling you how this gas street lighting situation appeals to me. I am not very artistically inclined; but in my estima-

tion the average lamp post is very ungainly and anything but beautiful. If this is so it would seem, that not a little effort should be expended by gas companies in trying to get artistic and ornate lamp posts along the highways and byways of the different towns and cities.

Mr. G. H. Waring (Charleston, S. C.): Mr. Chairman, the question of why gas companies have lost in some places the street lighting, was not because there was no money in it, but because of the policy of the company that lost the business. There is no question in my mind but that gas lighting is more profitable to the gas company than electric lighting is profitable to the electric company under the existing rates.

About 10 years ago I was interested in a little company in Nebraska, and we had both gas and electricity. This company had no street lighting. It was up to the owners to decide which to light the streets with, gas or electricity. The first question that confronted the property owners was the investment.

The question of investment was overwhelmingly in favor of gas. The mains covered the city fairly well; and of course if the electric investment was put in, it necessitated putting in circuits all over the city.

A great many gas men have an idea—I will not say a great many, but a few men have the idea that all you have to do to get electric lights on your streets is to tap your electric line the same as you would tap your gas mains. Whereas, as a matter of fact, new investments must come from the central station to the lamps as laid out, and the investment is very high; and that alone should influence gas men in going for this business, as the investment is so comparatively small, whereas with the electric man it means a great deal.

Another advantage in gas lighting over electric lighting is the question of service. In Charleston where I am located, in the past 6 years we have had the electric lights out in one case nearly 30 days, and in another case for a week.

We had a similar wind storm to what they enjoyed in Pen-

sacola yesterday. Our wind storm was only 105 and theirs was 110 miles. I venture to say that Pensacola will not have any electric lighting for 30 days from yesterday at the very least.

That has appealed to all the people along the South Atlantic and Gulf Coast as to the reliability of gas lighting. The central electric station where they come on with their peaks and at times where they are not able to get generating capacity to take them over their peak, the first thing they sacrifice is the street lighting. I have been in a city in the winter months, where right over the peak, arc lights were put out the street, just at the time people were going home.

I know of two winters in Omaha where that was the case. The lights were turned out just as everybody wanted to go home. The railroad peak was on, and the electric light company in the central station could not meet the demand. The gas company is ready to meet that demand at all times, and the investment is small.

The only problem we have is one that should be solved by the gas engineers as to labor cost of the lighting and extinguishing, which I think is very great at the present time, and I do not believe the methods have proved a success by "jumping" systems or other systems that have been put on the market. But they should be improved upon. There is no question in my mind if the gas fraternity goes after the street lighting business they can get it and hold it.

The question of an artistic post is, a thing that should be given a great deal of consideration. I took a ride around Chicago yesterday, and I was very much impressed with the fact that some old gas lamps had been converted into electric lights and were very ugly; those same old posts you are all familiar with; whereas the new electric posts that are being put in are of concrete, which are very ornamental. That is the thing I think you should bear in mind when going into the street lighting; that is very important.

THE CHAIRMAN: We are very much obliged to Mr.

von Maur for bringing us such a fine collection of photographs which indicates much progress in street lighting.

Mr. E. H. Earnshaw (Newark, N. J.): If it is not too late, I would like to ask Mr. Riley the reason for bumping those governors?

Mr. Riley: We have found in some cases, that these governors lose their adjustment and pass more gas than 3 cubic feet per hour. They rarely go the other way, that is, under 3 cubic feet per hour. Through some reason or other the screw will work out. Of course, after we put the fire-clay cement on the set screw and allow it to dry and harden, some of them may still be loose. Hence we agitate them, for street traffic might cause them to work out. Since testing out these governors by bumping, we find about 15 per cent. will not pass, and we have to take out the set screws and readjust them. It pays us to detect and reclaim this 15 per cent. through the medium of bumping.

Mr. R. B. Brown: We are very much interested in the subject of Street Lighting and we have been doing considerable work in Milwaukee along what are somewhat original lines in co-operation with engineers who were retained by the city for an exhaustive study of street lighting conditions. Mr. Westermaier of the Street Lighting Company and I have co-operated with them for over 2 years in their investigation. They have decided upon a type of light which is very different from that shown at St. Louis. But as yet we have not had enough installations to have really obtained any practical ideas as to how it is going to work out on the street.

We have some sample installations that have been running about a year. But there are not enough of them to tell very much yet. This has been worked out with an ornamental concrete post, and I think we have the best concrete post made to-day. It is made in a centrifugal machine which gives a very hard surface and a dense concrete, and adapts itself to use the various mixtures which govern the beauty of the post. They are using a fine mica schist which makes a very beautiful post. Then the lantern is of the refractory type, a bowl-

shaped refractor which is made with double surfaces, inner and outer surfaces with the prismatic surfaces turned in, so the surfaces exposed to the inside and outside are plain and smooth so that they can very readily be kept clean; this is designed to give a theoretical distribution which Mr. Sweet, the engineer appointed by the city, had worked out from an entirely theoretical standpoint on some rather extreme theories that he has as to the effect of glare in street lighting.

We feel that there are some points in his system that are very much open to question as to their utility. But on the whole, they are certainly getting more efficiency out of the given unit light source in the collective distribution to the street than anything else that has been tried. Whether that efficiency is purchased at the expense of other perhaps equally important practical considerations, we do not know yet. I think we can tell you a good deal more about that in a year's time.

Mr. F. V. Westermaier (Philadelphia): Mr. Chairman and gentlemen, I would like to amplify, in a way, Mr. von Maur's description of the new types of gas street lighting units installed at St. Louis.

Although the street lighting contract has still 4 more years to run, with what is known as the single upright mantle boulevard type of lamp specified, the rapid increase of traffic throughout the gas lighted districts required that due consideration be given to providing the necessary increased degree of street illumination. To meet this condition the Laclede Gas Light Company and the Welsbach Street Lighting Company of America have co-operated to demonstrate to the city what can be done with improved gas units of higher candle-power, the general description of which was fully covered by Mr. von Maur's talk and views.

Before any extensive demonstration was made, one of the city supervisors of lighting decided that it should embody the use of a post which could be considered as a standard for either gas or electric units. As a result of a competitive test,

the design shown on the screen this afternoon was approved by the art jury and adopted.

After this was done we designed fixtures of 120 and 220 candle-power, which are not only practical but remarkably efficient on low rates of gas consumption. The next step was the design of lanterns adapted to the lines of the standard post, resulting in the development of two distinct styles of lamps, classified as Types "D" and "E."

The Type "D" unit comprises a 15-inch diffusing glass globe, copper ventilator, cast metal bowl, having an elevating ring device for raising the globe to make mantle and chimney replacements, and an adapting socket to fit the standard post.

The other style, Type "E" unit was designed along the same general lines as the Kingshighway viaduct lamp, but so modified as to enhance operation and improve the appearance by providing for the illumination of the dome. The lines of the bowl were altered to be in keeping with the design of the new post. The globe used with this lamp is of special mould to fit the lines of the supports, and a paneling effect of the diffusive glass dome is obtained by the use of copper strips between the ventilator and the crown.

The latter lamp is fitted with 220 candle-power fixtures and the former, or Type "D" lamp with 120 candle-power fixtures. These fixtures belong to the class having upright Bunsens, with head cluster fittings, carrying from two to four inverted mantles.

In addition to these special types of lamps, the regular boulevard lamps, with clear glass globes, are equipped with 120 candle-power double-inverted fixtures.

The city authorities have displayed considerable interest in the matter, and about a year ago granted permission for an extensive demonstration of the various units on two of the most prominent residential streets in the city, Lindell Boulevard and Kingshighway.

Although the cost of preparing for and making the demonstration has been very considerable to the two companies, without any additional revenue from the city for the increased

lighting service rendered, we feel that it has been the means of greatly overcoming that prejudice towards gas lighting, which is the result of general ignorance, on the part of the public, as to the illuminating possibilities of gas, and at the same time we have met the requirement for increased illumination on these important streets.

Referring to the Milwaukee street lighting situation mentioned by Mr. Brown, and particularly the design of the special type of gas fixture to be used in connection with the pendant holophane refractor, it is certainly very gratifying to state that the results obtained were equal in efficiency in lumens output to the same style of units using nitrogen filled tungsten lamps of the same candle-power.

Being committed to a particular theory in regard to street lighting, the engineers in charge of the survey made in Milwaukee at first were disinclined to consider any extensive use of gas in their plans. The practical demonstration of the gas units of this type has been so satisfactory that the plans now recommended to be carried out include over 2,000 gas units in a total of 8,800 units laid out, with a very strong possibility of the number of gas units being increased in the future to 300 or more.

The retention of gas at Milwaukee is in a large measure due to the optimism of Mr. Brown toward gas street lighting, and also to the fair-minded investigations made by Messrs. Vaughn and Sweet, the engineers for the city.

Mr. Chairman, I would like to submit a written discussion on the subject of "Street Lighting," which contains certain points which I feel should be of interest and of value to the gas fraternity.

THE CHAIRMAN: How much time will it take Mr. Westermaier?

MR. WESTERMAIER: About 3 or 4 minutes.

THE CHAIRMAN: I will give you 4 minutes.

MR. F. V. WESTERMAIER: (Written discussion.) Public service is certainly a privilege of the highest order, but it also

involves responsibilities far greater than those incurred in service limited to and between individuals. In the latter case, and in a purely commercial sense, service becomes an exchange of commodities brought about by the need of the purchaser for an article or product offered for sale and for which he pays a stated price. The transaction usually ends with the sale but is repeated whenever need on the part of the purchaser demands it. The satisfaction of the purchaser is measured by the degree of service rendered by the article or product he buys, and it is the aggregate of contented purchasers that build up large business enterprises. An axiom which is becoming more and more recognized in business, as time goes on is, "*Service* combined with sales brings *success*," and where this has been assiduously applied, success has been the result.

All our large mercantile and industrial establishments owe their existence above everything else, to the fact that they have learned to serve. A gas company or an electric company, enjoying a franchise giving it the sole privilege to sell its commodity to the community has responsibilities far greater than the merchant or manufacturer. The very nature of its product gives the company a monopoly, and monopolies to the average citizen are bugaboos and dangerous things to have around. This attitude is mostly due to the influence of demagogues, often unprincipled, and generally selfish, using the adverse sentiment they may inspire in the public, to further their own or their parties' particular interest. In view of this condition of mind of the public toward the companies furnishing gas, electricity, and transportation, they should become actually in fact, what the law terms them, "public service corporations," and through applied service remove the stigma imposed on them, gain the confidence of the public, thereby reaping the profits to which they are entitled, and, at the same time, establish themselves so highly in the estimation of the citizens that the efforts of character vilifying demagogues, will be fruitless.

The necessity of lighting city streets affords an unexcellable opportunity to gas companies to render a public service

which can bring much to their credit from the public. Street lighting is visual evidence of service and as it is performed, just so is public opinion formed, and the public is usually a stern critic due to the fact that it is the interested party. This service should, therefore, be of the highest order possible so that it may be above criticism and through its excellence, in charm and dependability, demonstrate the value of gas. The consumer who can find no fault with the product under the severe conditions on the street will be the easier to convince of its merits for his own domestic or individual purposes. Street lighting then becomes a demonstrating advertisement which brings a two-fold return to the company, public appreciation of service, and indirect, as well as direct increased sales of gas.

Gas companies, as a rule, have not appreciated the value and importance of this field for their product, as have their competitors, the electric light companies. Their attitude has been to follow the line of least resistance, erroneously consoling themselves that if their competitor took away a large part of the lighting business they could make up the deficiency in output by increasing the sales of gas for cooking and heating; a field in which gas is naturally stronger than electricity. The effect of persistence in such a policy to cause an economic loss in that maximum efficiency is only obtainable when the output is continuous and not intermittent. At the prevailing respective rates for coal and manufactured gas, the former is still, and will remain to be, the more economical all day and night fuel for heating. Gas is used and will continue to be used for heating as an auxiliary to the coal plant, but only at intervals when needed to raise the temperature locally. Cooking also is an intermittent demand, on the output in that it occurs periodically during the day; morning, noon and night. The lighting load, which comes on in the early evening, preceding the cooking and heating loads, is practically continuous through a large part of the night, serving to maintain the rate of output and to eliminate the peak period. In this way, the investment in the plant necessary to carry the short period high demand

loads is earning a return which is a material aid in improving manufacturing operation, and reducing operating costs. Obviously, if the lighting load is continued throughout the night, as in the case of lighting the streets, efficiency and returns are enhanced just that much more.

Many electric light companies, in the early days of competition with gas companies, depended greatly on street lighting to balance their plants as well as to advertise their product. To obtain the street lighting business, concessions in rates were made so as to enable them to introduce units so much superior to the then existing flat-flame gas lamps in candlepower, that electricity soon became a factor of the greatest menace to gas not only as a street illuminant but also for interior lighting. The introduction of the incandescent gas mantle checked the inroads made, and soon again gas arose as a worthy competitor, in the general lighting field, as well as in street lighting, which it now shares, almost equally with electricity.

The success attained in gas street lighting cannot be credited to the efforts of the gas companies, but, instead, to those operating street lighting companies that had faith in the real value of gas for the purpose, and confidence in their appliances and service organizations. This confidence coupled with the courage of their convictions, resulted, not only in holding business, which would have been lost to gas companies, but also in an actual increase in the number of gas units used as the communities grew in size. This growth came as a natural sequence of satisfying the purchaser, the public, and it will continue so long as satisfactory service is delivered. It is also substantiating evidence that public service to be successful must be specialized.

Since street lighting service is the specialized business of the operating companies, their very life depends on keeping up the efficiency of the service and the development of units to meet its ever increasing demands. Obviously the credit of successfully giving street lighting service redounds to the gas company, increasing its standing in the opinion of the public.

As a public service, street lighting should not be regarded in a commercial sense although it involves purchase and sale. When equal or better service is obtainable with a competing illuminant at a lower price, the favor of the public will be transferred, and, in view of recent developments in incandescent electric units, it behooves those having at heart the interest of gas lighting, to meet the coming situation in such a manner as will hold the confidence, and thereby the business, of the public served. This can be done only through the combined efforts of the gas manufacturing and the operating companies. If the former will appreciate, in time, the necessity of keeping their product in the service of the general public by illuminating the streets at rates which will approximate on the same scale those charged by the electric lighting companies for the same purpose, they will be performing their duties as public service corporations, and obtain for themselves the substantial rewards resulting from giving "service with sales."

The Chairman: Mr. Westermaier, we thank you very much for your contribution.

Mr. Arthur Hewitt (Toronto, Can.): (Written discussion communicated.) One of the most important requirements of present day gas is that there should be the least possible variation in quality. As a general rule it may be taken that 95 per cent. or more of the consumers now employ the atmospheric burner, with its delicate adjustments for both air and gas, and it is to the advantage of the gas company to see that once the preliminary adjustment has been made, the apparatus should require little further attention.

The proportion of carbureted water gas to coal gas must, however, be varied from time to time to suit changing conditions of manufacture. The flexibility of the plant while having advantages in one direction, presents serious disadvantages in another.

It is important, or one might say absolutely necessary, to maintain a supply of gas, unvarying in composition (and consequently in specific gravity within the closest possible limits),

so that the burners used for its consumption can be standardized, thus obviating the consumer's necessity of regulating the gas or air supply. This standardization of burners is almost an impossibility with those undertakings using two gases in varying proportions from time to time, differing at times to the extent of 20 per cent. in specific gravity.

I believe flame temperature to be an important factor in mantle lighting. Primarily it may be said to be dependent upon three conditions: (*a*) flame volume, (*b*) rate of combustion, and (*c*) calorific value. The first is of chief importance. The volume of flame depends upon the distance which the gas is forced to travel, in order to obtain sufficient air for its complete combustion, with high grade gas the distance will be greater than a low grade gas; thus in the latter instance the flame will be shorter. The point to bear in mind is that the smaller the space over which a definite number of B. t. u.'s are consumed, the greater will be the flame temperature. The shape and size of the flame must, however, conform to the shape and size of mantle.

Technically and commercially it is our object to maintain an article of dependable quality, without which assurance the efforts of the best salesmen can be nullified.

In this respect we cannot study our product too closely, from the chemical point of view.

Mr. Reed (Duluth, Minn.): The gist of this whole discussion I take it, is simply the matter of the labor part of the maintenance cost. We know that electric light has a great advantage over gas in that one single switch will turn out all the lights on the same circuit. We cannot do that with gas. We have to send a man around to turn the lights off and to turn them on, and it is a large portion of the cost. Some gas lighting plants in the smaller cities allow their gas to burn all day. It is cheaper even with the increased consumption of gas and the extra cost of the mantles and the globes, to leave the lights burning through the day, than to turn them off in the morning and to turn them on in the evening.

We are up against it as compared with electric lighting until

the gas appliance manufacturer gets up some device that will enable us to conserve the gas, globes and mantles, by some mechanism that will turn the gas off in the morning and turn it on at night and thus eliminate the labor cost.

I think that is the gist of the whole question so far as the comparison between gas and electricity is concerned. We know that the gas efficiency and quality of the light and in fact every other point of the gas service is as good if not better than electric.

THE CHAIRMAN: It could be said, I suppose, from what you have read of foreign installations, that they do have many towns in which an automatic installation works successfully. Would you say that?

MR. REED: I do not know. I am not informed. So far as my knowledge goes no successful apparatus in this country at the present time has come to my attention, but I will not say that there is not some successful device. But I do say that it is not in universal use.

THE CHAIRMAN: But you have read that there are successful ones in Europe?

MR. REED: Yes, sir.

THE CHAIRMAN: Then the difference between something in Europe and something in this country is furnishing the reason why we cannot do it, and they do it. That is the question then, for investigation. Now, much of that, I think, is traceable right back to the other talk early to-day, and Mr. Serrill's talk yesterday in another session in regard to what we must do with our fuel.

MR. REED: Yes, sir, the same thing applies.

MR. BEADENKOPF: We have in Baltimore a street lighting system employing burners which are operated by a clockwork mechanism in conjunction with a small pilot light, and I think I can say that it is being successfully operated. All of the city lamps are not operated that way, but there are in use about 4,000 of such lamps.

MR. REED: A large saving, Mr. Speaker, in that labor cost?

Mr. Beadenkopf: Oh, yes; no lamp lighters' time whatever. It is merely the cost of the clock. It is a very cheap clock and the cost of the tile, which does not amount to very much.

Mr. W. J. Serrill: I you have gas street lights, you must see that they are kept in fine condition. It is a serious mistake to skimp in the maintenance. If they are on the street to advertise gas lighting, to be worth anything as an advertisement, they must be kept in fine shape. If they are not a credit to the gas industry, if you do not feel proud of them when you are on the streets at night, you had better get rid of them altogether.

The street lamps in Philadelphia—the one-mantle lamp with boulevard lantern, and clear glass globe—are to my mind ideal for residence streets, where a high illumination is not needed. But in order to impart to them a first rate appearance, you must burn enough gas to fill the mantle. A partially filled mantle makes a bad impression. Our experience is that a consumption of 3 feet is not sufficient; 3½ feet make a better impression and the additional half foot is well worth while.

Mr. von Maur has shown us how beautiful are the ornamental gas lamps with opal globes, as used in St. Louis. I think they are handsomer than most of the electric lights that one sees on the streets.

I was to-day admiring the concrete posts mounted with opal globes in Chicago's parks, and on the boulevards. And yet, in the evening, when these globes were lighted, I experienced a sense of disappointment, because the incandescent electric filaments showed plainly inside the opalescent globes. The globe was not a uniformly illuminated surface, and to my eye such an effect is always ugly. The ornamental gas lamps that Mr. von Maur has shown you are free of that defect. They present a beautifully and uniformly illuminated surface. It is easier with a gas mantle than with an electric light to get such an effect, because the intrinsic brilliancy of the mantle is only

about one-fiftieth of the intrinsic brilliancy of the tungsten lamp.

The gas manager who has street gas lighting in his town, owes it to his company and to the gas industry to see to it personally that the lamps are maintained in creditable condition. Because the lighting contract may have been made between the Walsbach Street Lighting Company, or some other similar company, and the city department, constitutes no valid reason why the gas manager should say, "I have nothing to do with this; I am not responsible." In a vital sense he really is responsible; his product and his business are publicly judged by this street lighting, and he can well afford to spend money, if need be, to ensure a creditable effect.

With incandescent gas lighting I doubt whether street candle-power tests are worth while. One can judge by the eye. Clean glassware and well-filled mantles, evince good maintenance and a proper light. In case tests are required, there are convenient forms of illuminometers or portable photometers that may be used.

In Philadelphia we have in use a convenient inspector's gauge that was developed in the physical laboratory. The disc box containing the test light, slides on a wooden rod, which is held up against the street lamp globe by the inspector. The length of the rod is such and the instrument is so calibrated, that the inspector reads the approximate horizontal candle-power.

The Chairman: We have two or three pieces of business that we ought as a Section to attend to, and we have but a few minutes more time. As a result of this session have you any recommendations to be voted upon here, so that we can present the results to the general session to-morrow morning? Such as the appointment of committees, or continuation of committees? You can think about that just a moment while I am calling for the report from the gentleman who has been acting with the Committee of Three to select Vice-Presidential candidates for this Section for 1917. Mr. Forstall, will you kindly report?

Mr. A. E. Forstall: Mr. Chairman, your committee suggests F. H. Gilpin, C. A. Luther and Thomas Scofield as the three nominees from whom the selection of a Vice-President for this Section for 1917-18 is to be made.

Respectfully submitted,

Alfred E. Forstall, *Chairman,*
O. B. Evans,
Wm. J. Serrill.

The Chairman: Gentlemen, you have heard the committee's report.

Mr. Serrill: I move that the Secretary be instructed to cast the ballot for the nominees.

The Chairman: You have heard Mr. Serrill's motion that the Secretary be instructed to cast the ballot. Is there a second?

(The motion was duly seconded.)

(The motion was put and prevailed.)

The Chairman: The gentlemen whose names have been presented, will be considered as voted for.

Now, are there any resolutions to offer?

Mr. Serrill: Mr. Chairman, do I understand the Committee on Gas Illumination will be discontinued unless we recommend its continuance?

The Chairman: No, not necessarily. It is simply an expression of your opinion as to whether it should be continued.

Mr. Serrill: I move it be recommended that it be continued. We certainly need it.

(The motion was duly seconded.)

The Chairman: It has been moved and seconded by the Illuminating Section that the Committee on Gas Lighting be continued.

(The motion was voted upon and prevailed.)

THE CHAIRMAN: It has already been accepted by the Technical Committee, and the Board of Directors, and scheduled for presentation in this Section.

Are there any other suggestions?

MR. SERRILL: I think that committee report contained no definite recommendation that we were supposed to adopt in the form of a resolution.

THE CHAIRMAN: The report?

MR. SERRILL: The report of the committee. I do not think there was any definite recommendation.

THE CHAIRMAN: No, there was not.

MR. SERRILL: I move we adjourn.

THE CHAIRMAN: Gentlemen, I adjourn the Illuminating Section.

Adjourned.

DISTRIBUTION SECTION.

First Session, Wednesday 11 A. M., October 18.

Mr. J. D. von Maur, *Vice-President,* presiding.

Mr. G. I. Vincent, *Secretary.*

The Chairman called the meeting to order at 11 A. M.

The Chairman: The first paper on our Distribution Section program is "Gas versus Electric Cooking," prepared by Messrs. S. C. Bratton and G. D. Mantle. As neither of the authors is present, the Chair will call upon Mr. Frick, who has kindly consented to read the paper.

GAS VERSUS ELECTRIC COOKING.

Permit us to introduce to the American Gas Institute, Benjamin Thompson; first Massachusetts 'prentice boy, afterward British soldier, and successively, Count Rumford of Bavaria, founder of the Royal Institution of Great Britain and citizen of Paris, but most important of all the father of scientific cookery. Unfortunately the introduction is somewhat late. Had it been made earlier this body of the ablest gas men of the most enterprising country of the world, would not be called upon to consider the competition of a form of heat energy selling for at least five times as much per thermal unit.

The foregoing paragraph may seem unduly sarcastic, but when one considers the work done by Count Rumford, such notable successors as Dr. Robert Hutchinson, Sir Henry Thompson and Dr. Matthieu Williams, in England, and the long line of notable dietists that this country has produced, one entirely fails to understand how the thorough consideration of the operations which a gas range is designed to perform should have been overlooked.

We have to recognize that cooking is as much a branch of chemistry as the manufacture of gas, and unless the lessons that are daily being taught in our domestic science schools are taken to heart by the gas companies the history of gas lighting will be repeated and we shall have to wrest from a competitor business which has been, and should still be, ours.

It is easy to realize that in the days of the coal and wood range it was impossible to follow out the theories laid down by Count Rumford and his successors, on account of the great difficulty in controlling the temperature of the oven, and it would naturally be expected that when the gas industry made its first entry into the cooking field its chemical engineers would design an appliance which would take full advantage of the flexibility and ease of control of their fuel, and follow out in detail the principles of scientific cookery, which were even then thoroughly recognized.

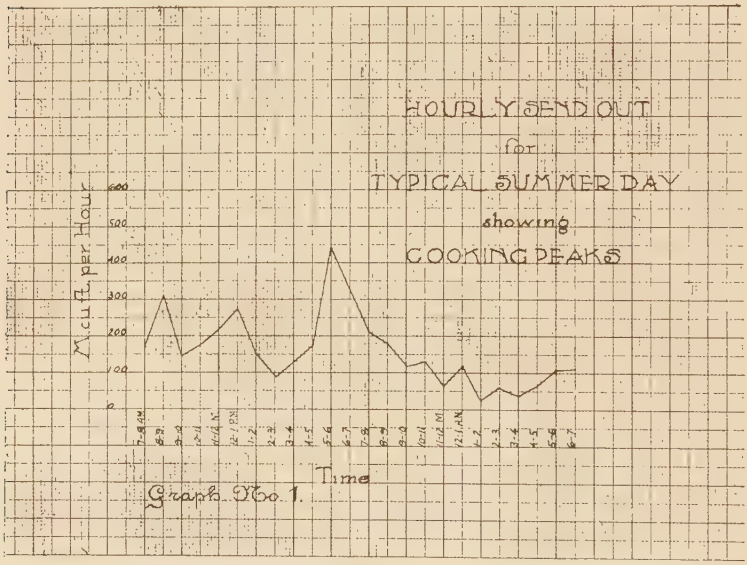
What they actually did was to take the oven of the coal stove, drill some holes in the top and bottom to allow a circulation of heated air from the burners, set it up on four legs and immediately commence a correspondence with the manufacturers regarding a reduction in prices. This correspondence still continues. Consequently from the standpoint of efficiency the gas range of twenty years ago is the gas range of to-day and efforts made by the manufacturers to encourage a more scientific and efficient appliance have received no encouragement which would warrant them in spending any sum on the publicity necessary to acquaint the public with the advantages of their product.

The day is late, but fortunately not too late, and if the gas industry will only follow the example of the electrical industry in getting together to educate the public as to the true merits of their commodity and to encourage the sale of an appliance which is most scientifically adapted to carry out the work for which it is intended, there is little to fear from electric competition. Such ranges are even now on the market and only await the publicity which is due them to rapidly replace the old time inefficient appliance.

Progress Made by Electric Cooking.

Electric cooking as a commercial proposition dates back only to 1890, yet to-day at least three hundred electric supply companies in the United States and Canada offer special rates to users of electric cooking appliances and are actively competing for this class of business.

Unfortunately the authors in the time at their disposal have been unable to collect reliable data showing the progress that the electric companies have made in the United States as a whole, but to the report of the Committee on Electric Ranges of the Northwestern Electric Association they are indebted for figures relative to the States in the Northwest and on the Pacific Coast, including Arizona, California, Colorado, Idaho, Montana, New Mexico, Oregon, Utah, Washington, Wyoming, Nevada and Hawaii, and these are probably representative of other sections of the country.



Graph No. 1.

At the date of the report there were in these States, 2,485 users of electric ranges, whilst the spirit in which the electric companies are entering the cooking field is shown when they state that their estimated purchases for 1916 would amount to 4,975 ranges, while the number of live prospects is given as 173,296.

The rate per kilowatt hour ranges from 10 to 3 cents with a tendency to adopt the latter figure as a standard in the larger cities. The average revenue from cooking being $40.00 per annum per consumer.

A considerable number of the consumers included in the above figures are in towns where gas is not available, but the proportion is not sufficient to justify the most optimistic gas man in believing that the electric companies are not already making inroads on our cooking load.

In many cases the cost of generation would scarcely seem to warrant the electric companies in giving the low rates now in effect for electric cooking, except on the basis of a greatly improved load factor, and that a cooking load tends to decrease the diversity factor of a city with even an average power load, is seriously open to doubt. The accompanying output curve of a typical gas undertaking on which the cooking peaks can be plainly seen brings out this point clearly.

This view is strengthened by an article by R. C. Powell, Superintendent of Electric Distribution of the Pacific Gas & Electric Company in the *Journal of Electricity, Power and Gas* of December 5, 1914, for he shows that in a city where all the cooking, lighting and heating is done by electricity, the regular load factor for lighting and power purposes would be 59 per cent., the factor for heating and cooking alone, 33 per cent., and the combined load factor only 40 per cent.

The Construction of the Electric Range.

The principles underlying the design of electric ranges are beyond the scope of this paper, but a brief description of their general construction is necessary for an understanding of the validity of the claims made for them by manufacturers and salesmen and it is certainly worth the while of every man who has the good of the gas industry at heart to carefully inspect and test for himself one or more of the more widely advertised ranges and it is only by knowledge gained in this practical manner that the proper sales policy can be adopted.

In the arrangement of the cooking top, ovens and broiler, advantage has been taken of the experience of the gas range manufacturers, in fact at a little distance it is difficult to distinguish between the two. The cheaper ranges selling at around $50.00 are similar to the low oven cooker while the

more expensive models follow the arrangement of the cabinet gas range.

The finish of the ranges internally and externally is on the whole very high and in some of the models the burnished surface of the castings is a great improvement upon the enamel usually employed as it will not chip and does not readily scratch nor rust.

The ovens are all heavily insulated with from 2 to 4 inches of mineral wool, kieselghur or poplox and until quite recently no arrangement was made for ventilation, with the consequence that the acrolein (formed by the disintegration of fat at high temperatures and very irritating to the mucus membrane) was held in the oven until the door was opened and then poured into the eyes and down the throat of the cook with tearful consequences.

In the majority of later models, however, a vent about 1 inch in diameter is provided at the rear top of the oven. The manufacturers claim that this vent has no effect on the thermal efficiency of the oven, but a series of careful tests made by the authors show a difference of nearly 10 per cent. in favor of the earlier model.

The elements consist of wires or strips of nichrome, calorite or other high resistance material treated during manufacture by a calorizing process which to a large extent prevents oxidation even at a red heat. Each element is divided into two sections with connections which enable them to be used either in parallel, separately or in series, thus giving three heats.

The units are usually placed at the top and bottom of the oven and together with the shelf supports are readily removable. This feature and the rounded corners enable the oven to be quickly and thoroughly cleaned by wiping round with a cloth and there are no projecting surfaces or crevices for the accumulation of dirt and grease.

Broiling can readily be accomplished either in the separate broiling oven or by using the top element of the bake oven and although the operation is considerably slower and more

expensive than with gas the results equal those obtained by any other method.

The arrangement of the cooking top is similar to that on a gas range, either two or three standard elements taking a maximum of 880 watts and a giant element taking 1,500 watts being provided. These elements consist of a high resistance wire wound in the grooves of a disc of insulating material, the surface being either exposed or covered with an iron plate. In at least one model this is supplemented by a fireless cooking pot, the lid of which is flush with the cooking top. The surface surrounding the elements is flat and can be readily kept clean.

Comparative Efficiencies of Gas and Electric Ranges.

It is essential that figures used for comparative purposes should be those obtained from tests made under average working conditions, and though the monthly bills of similar houses and apartments are compared later, *these figures are unreliable owing to the fact that the average user of an electric range is so thoroughly impressed with the fact that it is necessary to be economical that she does not use it to nearly the extent that the average gas consumer uses hers.*

Absolute efficiency tests are difficult to make but the result of a careful series of tests on a modern electric oven gave an average thermal efficiency of 76 per cent. and a similar series on the ovens of three makes of gas ranges showed an average efficiency of 30 per cent.

These tests were so carefully made and checked that they may be assumed to be correct and it is therefore possible to arrive at rates which would place gas and electricity on an equal footing when used in modern ovens.

Gas of 600 B. t. u. value at $1.00 per 1,000 cubic feet, used in an oven of 30 per cent. efficiency gives 1,800 effective thermal units for 1 cent. Electricity at 3 cents per kilowatt hour (3,412 B. t. u.), used in an oven of 76 per cent. efficiency gives 864 effective thermal units for 1 cent. In other words electricity at 3 cents per kilowatt hour is equal to gas at $2.08 per

1,000 cubic feet. It must be understood that this comparison applies only to the oven for, as will now be shown, the comparative thermal efficiency of the hot plate is even more in favor of gas.

The test of the efficiencies of the cooking tops was purely a relative one and no attempt was made to ascertain the theoretical efficiency.

An ordinary round open, aluminum saucepan 6¼ inches in diameter at the bottom and containing a pint of water was brought to boiling point from an initial temperature of 56° F. first on the standard element of an electric range and then on the standard burner of a gas range. Similar tests were then made with a quart and two quarts of water in the same vessel. The results are tabulated below:

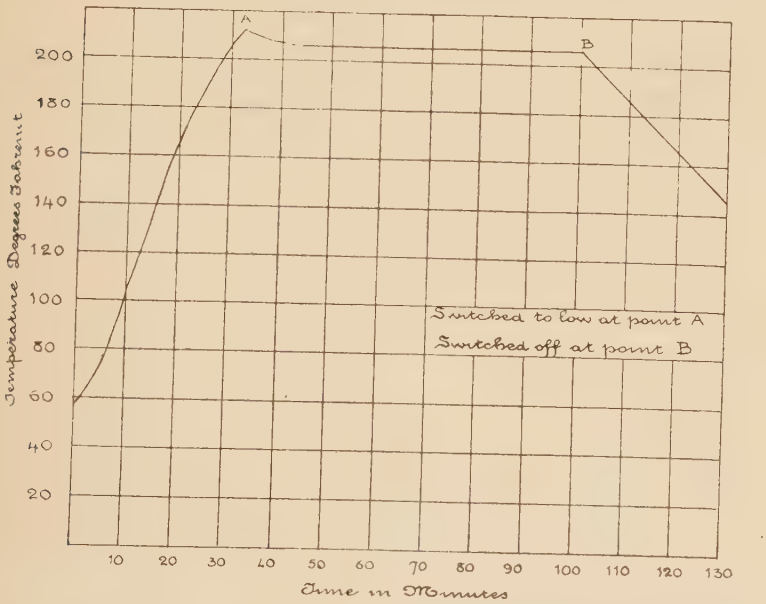
Quantity of Water	ELECTRICITY			GAS (572 B. t. u.)			Electricity at 3 cents per K. W. hour equals gas at per 1,000 cu. ft.
	Time Minutes	Watt Hours	B. t. u.	Time Minutes	Cubic Feet	B. t. u.	
1 Pint	12	253	863	3 m. 10 s.	1.2	686	$6.65
1 Quart	17	359	1225	5 m. 55 s.	2.2	1258	5.15
2 Quarts	25	534	1822	9 m. 24 s.	3.8	2173	4.44

As however more heat is retained in the electric hot plate than is retained in the burner and grid of a gas range a further test was made in which the electric element was given full advantage of this, a case which would rarely arise in practice for the low heat is not as a rule entirely switched off until the vessel is removed.

Having first noted the reading of the meter and initial temperature of the water, two quarts of water were brought to boiling point by applying the full heat (1,200 watts), of a standard electric hot plate. Immediately boiling point was reached the switch was turned to low (300 watts), for one hour and then turned off and the meter read. One minute temperature readings were taken from the moment of boiling until the temperature of the water dropped to 150° F., below

which point the heat would be of little value. The curve obtained is reproduced herewith (Graph. No. 2).

A similar quantity of water in the same vessel was then brought to boiling point on the standard burner of a gas range and immediately transferred to the simmering burner and the flow of gas adjusted by hand so that the temperature followed the curve previously obtained on the electric hot plate and the



Graph. No 2

consumption found to be 0.9 kilowatt hour of electricity and 9.5 cubic feet of gas or 3,070 and 5,415 B. t. u. respectively. Thus making electricity at 3 cents equal to gas at $2.99 per 1,000 cubic feet for simmering operations.

The fireless cooking feature need not be taken into separate consideration as it is an accessory which can be added to any gas range and the comparative costs would then be the same as in the case of boiling.

In order to complete the tests it was necessary to find out what proportion of the operations on a range utilize the oven, or the top burner for simmering or boiling, and in order to ascertain this, careful records of the gas consumption on each of these items were taken in a number of average households over a period of one week. The following being the proportions:

Average total consumption 490 cubic feet. Operations utilizing the oven 125 cubic feet. Simmering 260 cubic feet and boiling only 105 cubic feet.

Taking therefore the relative costs obtained above and dividing them in these proportions we find that in the all round operation of the gas range *electricity at 3 cents per kilowatt hour is equal to gas at* $3.20 *per* 1,000 *cubic feet.*

The figures given above do not include the heating of any water except that usually heated on the range as a gas water heater was used for all other purposes.

Some Gas and Electric Cooking Bills Compared.

Having arrived at a fair basis of comparison of the cost of cooking on gas and electric ranges it may be interesting to compare the monthly bills of some representative installations based on electricity at 3 cents per kilowatt hour and gas at $1.00 per 1,000 cubic feet.

The electric installations selected are those in five apartment houses situated in Great Falls and Anaconda, Montana; Salt Lake City, Utah, and Portland, Oregon. In these apartments there are 135 ranges with an average consumption of 89 kilowatt hours per month and an average bill at 3 cents per kilowatt hour of $2.65 per month.

Compare this with the gas bills from similar apartment houses in which with a total of 121 gas ranges there is an average consumption of 1,170 cubic feet per month or at $1.00 per 1,000 cubic feet, $1.17 per apartment per month.

In both cases allowance has been made for the periods during which apartments have been vacant.

The contention that owners of electric ranges are afraid to

use them on account of the high cost is borne out not only by comparing the above average bills with our test figures but by the opinions of users themselves, for, from all these cities come reports of dissatisfied consumers complaining of slow cooking and high bills. With one exception, later apartment houses built by the same owners have returned to gas ranges and in the case of the exception the wiring and ranges were furnished free by the electric company, a policy which the gas company concerned did not see its way to adopt.

It is interesting to note that the opinion of the user of electricity for cooking in an apartment house is as a rule unbiased; whereas Mrs. Smith, who has invested $75 to $100 in an electric range of her own would not be a true woman if she admitted to Mrs. Jones that the latter's $40 gas range was both more economical and more convenient.

A Few Words on the Small Appliance

How many of us have stopped to imagine the consumption which the small electrical domestic appliances have stolen away from the Gas Companies?

One large supply company estimates an average revenue of 30 cents per month per consumer from this source alone and when one considers the enormous number of these appliances in use and that an electric iron takes 500 watts and an electric toaster 440 watts, the loss of revenue begins to be appreciated.

The cost of operation is in the neighborhood of three times that of gas to achieve the same results but as little or no effort has been made by the gas companies to produce an article as attractive in appearance and convenient in point of connection there is little inducement to the consumer to purchase small gas appliances; and until the gas companies make it their business to see that every house is piped for gas and convenient socket connections installed there is little hope of regaining this lost ground.

Though the consumption of these appliances represents in the aggregate a possible gas consumption which is not to be

despised, the moral effect on the housewife is even more important and the development of any competitive form of appliance by the manufacturers is well worthy of the support of all New Business Departments.

Advantages Claimed for the Electric Range.

In discussing the progress and possibilities of electric cooking the electrical press and the leading manufacturers have shown a fairness which is a credit to the great industry they represent and this credit is due not so much from a moral standpoint as in recognition of the skill with which every point which might fairly be claimed has been brought out without the inclusion of misleading statements.

Unfortunately this policy has not been followed by the salesmen and demonstrators of the majority of electrical supply companies and it is high time that some concerted action was taken to publicly refute the exaggerated and even ridiculous statements which are being made to thousands of people daily.

The following are verbatim extracts from a lecture which is given daily in the electric salesroom of a large city and at which there is an average attendance of more than fifty people.

> "The electric range as far outstrips the gas range in convenience and true economy as the gas range did the old coal and wood range. For cooking purposes electricity at 3 cents per kilowatt hour is equal to gas at $1.00 per 1,000 cubic feet, so that with the 10 per cent. cash discount electricity is actually the cheaper fuel.
>
> "When the saving due to the decreased shrinkage of meat is taken into consideration, electricity is so much the cheaper fuel that it actually pays every woman to take advantage of our deferred payments and install an electric range in her kitchen at once. This saving in shrinkage has been proved by the foremost scientists to be equal to at least 25 per cent. of the original weight of the meat and therefore represents a saving of 25 per cent. of the butcher's bill.

"In the electric oven the heat is all generated in the oven itself or immediately under the kettle and it is not necessary to heat a large volume of air which passes either up the chimney or, with the injurious carbon monoxide from the gas, into the room.

"All the heat generated passes either into the meat or into the water and does not pass through the oven walls into the kitchen as is the case with a gas range. Consequently the electric housewife has her beautifully cool, clean kitchen even on the hottest summer day, whilst the gas cook, red and perspiring chokes in a vitiated atmosphere.

"The electric heat is always the same for a given switch position so that in a few days the cook can bake or roast anything to a turn without opening the oven. If you are using a gas range and your neighbor turns on her gas at the same time your gas pressure falls and you wonder why sometimes your pies are burnt and sometimes only half cooked.

"All doctors and dietists agree that food cooked in an electric oven is far more tasty and nutritious than that cooked in any other way. The difference in your cooking when you have your electric range will astonish your family and friends and you will wonder how you endured the old unevenly cooked, gas-tasting meals."

In answer to a question as to how the higher cost of electric ranges could be saved in the case of an apartment house, the demonstrator suggested that all gas piping and chimneys could be eliminated.

These remarks may not be representative of the attitude of the higher electrical officials but they certainly are a fair sample of the statements of salesmen and demonstrators in many of our largest cities.

To the gas man the arguments presented above are merely ridiculous *but are they so to the general public?* This question is a pregnant one and until the gas companies realize that their consumers and prospective consumers have to be

educated to the point at which they can place the true value on statements such as those just cited the electrical companies will continue to gain our consumers.

An Analysis of the Claims Made for the Electric Range.

The majority of the claims cited above are so devoid of reasonable foundation that one is almost inclined to dismiss them all lightly but there is a substratum of truth which makes some of them well worth analyzing. For the sake of clearness, each will be treated separately in the form of query and answer.

(1) *How does electric cooking compare with gas in cost?*

It has already been shown that under similar conditions gas burnt in a range of the pattern in general use costs 68.8 per cent. less for the same results than electricity in the latest type of electric range. The figures being based on dollar gas and 3 cent electricity.

(2) *Is the shrinkage of meat roasted in a gas oven materially greater than that roasted in an electric oven?*

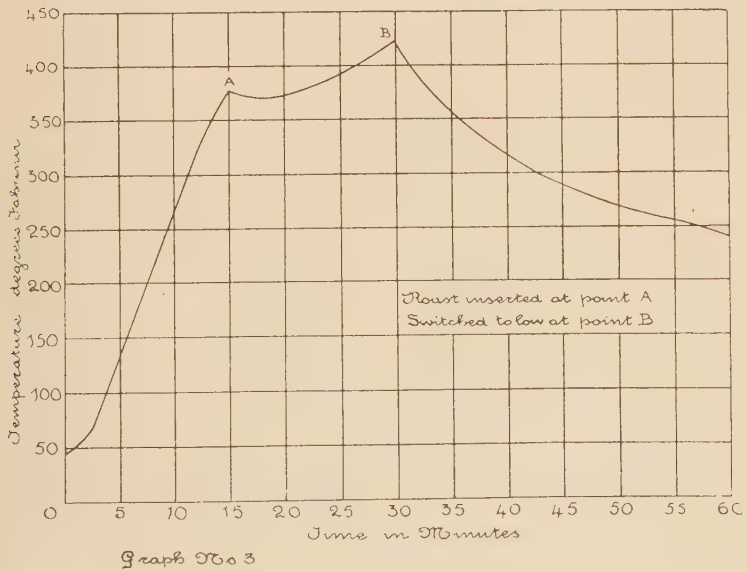
This is the great argument of the electrical salesman and the result of a series of tests on roasts containing as equal an amount of fat as possible show an average shrinkage of 16 per cent. in the case of an electric oven and 28 per cent. in the case of a gas oven. Both tests were made on roasts cooked in the manner recommended in the cook books furnished with the ranges.

Sir Robert Hutchinson in his book "Food and Principles of Dietics," shows, however, that this loss consists almost entirely of water; the loss of nutrient constituents being negligible and were it not that this water is a valuable aid to digestion the advantage claimed for the electric range in this respect would warrant little consideration.

As, however, dietists are unanimous as to the value of the water, a further series of tests was made to ascertain if the temperature at which the roast was cooked had any influence on the shrinkage.

For the purpose of the test an electric range with elevated oven was used and the instructions given in an electric cooking book were observed. These instructions read as follows:

> "Place the roast in the oven at a temperature of about 350°. After it has been in the oven for 15 or 20 minutes sufficient to seal the meat the switches should be turned to low. This being usually sufficient to allow the temperature of the oven to drop to between 212° and 190° and to maintain it at that temperature. For beef allow 15 minutes per pound, after taking the 15 to 20 minutes required for the first heat."



Graph No 3

These directions were carefully followed and after 16 minutes the oven was found to have attained a temperature of 378°, at which point a roast of beef weighing 2 pounds 1½ ounces, was inserted and five minute readings of the electric thermo-couple gave curve No. 3 reproduced herewith. At the expiration of 45 minutes from the insertion of the roast

it was removed and found to weigh 1 pound 12½ ounces; a shrinkage of 14.9 per cent.

A roast as similar in quantity of fat and size as possible and weighing 2 pounds 3½ ounces, was placed in the oven of a gas range at the same initial temperature and the heat regulated to follow the curve obtained upon the electric range. At the conclusion of the same period it was found to weigh 2 pounds exactly; a shrinkage of 10 per cent.

Allowing, therefore, for a slight difference in the quantity of fat in the roasts it would appear that the shrinkage is entirely a question of the temperature at which the meat is cooked.

These tests were later checked by a series of others under similar conditions and the difference in the amount of shrinkage in both cases was so slight, sometimes in favor of gas and sometimes in favor of electricity that it is *certain that the shrinkage is entirely a matter of temperature and is directly proportional to the temperature at which the roast is cooked.*

It may be interesting to note that in this case the consumption of electricity was 1.2 kilowatt hours and that of gas 13½ cubic feet, which checks the tests previously made.

The roast cooked in this way was, if anything, superior in juciness and flavor to that cooked in the ordinary way and it would appear that the temperatures given in standard cook books are far too high, whilst those in the electrical cookery books are more nearly correct.

As an example, Eva Roberta Robinson in "Lessons in Cooking Through Preparation of Meals," states that roast meats should enter the oven at 480° F. and be kept at 350° F., whereas Maud Lancaster in her "Electric Cooking and Heating," says that roasts should enter at 265° and remain at from 190° to 212°.

The initial figure given by Miss Lancaster is too low for the thorough searing of the meat but the results obtained would justify one in believing that the temperature she gives after searing is more accurate than that of Miss Robinson and

the proper temperature would appear to be 350° for searing and 200° to 220° for the remainder of the period.

(3) *Has the gas burnt in a range any harmful effect upon the atmosphere of the kitchen?*

With a properly adjusted burner and a well ventilated kitchen it is certain that it is no more objectionable or injurious to health to cook with a gas range than with an electric range. The only odors from a gas range under these conditions are those from the cooking itself, and proper ventilation is essential in either case. Both gas and electric ovens should be vented to a chimney and tests on the air of a properly designed gas kitchen show that, as in the case of gas lighting, the atmosphere is actually more hygienic than in one equipped with an electric range.

(4) *Does food cooked by gas taste of gas?*

In order to determine the answer to this question 12 slices of toast were made on the type of toaster used on a gas hot plate and 12 slices on an electric toaster. The slices were distributed amongst eight people who were not aware of the nature of the test but were simply asked if they could detect any difference in the flavor. Only one would say positively that there was any difference, and he, guessing the argument that was being decided, proved the influence of the imagination over the senses by stoutly protesting that the slice cooked on the electric toaster tasted of gas!

(5) *Does the gas oven raise the temperature of the kitchen to an objectionable extent?*

The loss due to radiation from a gas oven is approximately 15 per cent. of the total heat and this must therefore raise the temperature of the surrounding atmosphere to some extent, but the objection is more imaginary than real and the remedy is simple—a properly insulated oven and as short a length as possible of vent.

(6) *Are the variations in pressure on city mains sufficient to affect the operation of the range?*

In the majority of cities such care is taken to maintain an

even pressure over the entire system that such differences of pressure as do exist would have a negligible effect upon the operation of a range.

On the other hand it is interesting to note that as *the heating effect of electricity is equal not to the voltage but to the square of the voltage, a small variation in electric pressure will have a comparatively large effect on the efficiency of the range and electric range manufacturers themselves point out the necessity of the maintenance of proper voltage if satisfied consumers are to be assured*

(7) *Is food cooked the electric way superior to food cooked the gas way?*

If this question is taken to refer to any inherent advantages of electricity for cooking purposes the answer is in the negative. It is obvious that heat from an electric source differs in no respect from that from any other source; it is, however, generated without flame and therefore requires no oxygen to support combustion and can be applied in an airtight chamber. This advantage is, however, discounted in the case of the electric range by the fact that all ovens require some degree of ventilation and gas ranges are on the market which do not permit the products of combustion to pass through the oven.

If, on the other hand, the question refers to the operation of cooking as generally carried out on electric and gas stoves respectively, it is necessary to take into consideration the theory of cookery and the results of the investigations conducted by Count Rumford and his successors.

In the first place the general impression that cooking increases the digestibility of meat is erroneous. It has, if anything, rather the opposite effect, the object being rather to render it more agreeable to the human palate and to bring out flavors not present in the raw state by chemical changes which take place during the process.

The effect of heat upon the proteids of food both animal and vegetable is to coagulate them, but it is a mistake to think that a high temperature is essential to bring about this change.

If the degree of heat applied is much more than 170° F. the proteid tends to harden and shrink and the digestibility and flavor of the food in which it is contained is proportionately lessened.

Application of a higher degree of heat has however a different effect upon the surface of the roast, for it brings about a change in the exposed extractives similiar to that which sugar undergoes on conversion into caramel and forms a sort of impenetrable covering of varnish.

Meat is a poor conductor of heat and the proper procedure in cooking a roast is, therefore, to first apply a high degree of heat in order to seal the surface and then cook for a long period at a temperature of about 200° F. The sealing retains all the natural juices and flavor in the roast and it is really boiled in its own liquor; the ideal way.

Try the following experiment in your own homes:

Take your favorite roast and place it in an oven at a temperature of 350° F. for 15 minutes then allow the thermometer to gradually drop to 200° F. and remain there for a further period corresponding to 20 minutes per pound of the weight of the roast.

You will find the resulting roast apparently underdone, owing to the fact that it is really boiled, but we are much mistaken if it is not the tenderest and tastiest piece of meat you have ever had. Further the gas consumption will be half that for a roast cooked in the ordinary way.

We cannot say that we experience any of the thrills of the great inventor in discovering this; Count Rumford probably experienced that thrill hundreds of years ago, if one can judge by his facinating journal. Our feeling was rather one of shame, that we, personally making our living in the gas industry should only recently have realized the truths that have been taught by the Count and succeeding dietists for all these years and we wish it to be understood that any strong statements in this paper are deserved as thoroughly by the authors as by any brother members of the industry.

The Omission of Gas Piping in Buildings.

This policy would not be a far sighted one on the part of the owner of the building and its adoption would speak but poorly for the enterprise and ability of the officials of the gas companies concerned. There are, however, large buildings, apartment houses and even hotels in our cities to-day which do not contain a single foot of gas piping.

Little blame can be attached to the owner of the property and if the gas companies are not enterprising enough to bring before the public at large the real merits of their commodity and recommend appliances which annihilate every advantage that electric cooking can claim, theirs and theirs only is the blame.

Proper Publicity Methods.

There is little doubt that the average electric supply companies and manufacturers have larger advertising appropriations than do the gas companies but even so it is seriously open to doubt that the money expended is applied to equal advantage.

How many gas companies realize that their advertising manager is a salesman who reaches thousands of homes daily, that he can get a hearing when the ordinary solicitor would be refused and that he is just as able to use his personality as though he made a personal call?

The advertising of some of the larger gas companies is of a very high order and equals that put out by any industry, but on the whole the standard is lamentably low and is confined to bald statements, which have no psychological value whatever. Little "good-will" advertising is done, yet this is invaluable in keeping the consumer alive to the advantages of the commodity we sell and if properly handled would effectually prevent the electrical companies from taking a foothold on the cooking business.

Again our demonstrations and distributions of information are confined to National Gas Range Week and similar campaigns, whereas a bi-weekly or even weekly cooking class open

to the public, not only tends to an appreciation of the advantages of gas but helps to increase the consumption by encouraging the housewife to attempt new dishes. It also has the effect of minimizing that bugbear of all Public Utility Companies, high bill complaints.

Our future purchases of ranges should be provided with thermometers as a standard and we firmly believe that this is an essential part of the equipment of every range and all published receipts should state the correct cooking temperature.

Gas ranges are already on the market which compare very favorably in efficiency and convenience with the best electric range and at least one of these manufacturers advertises the advantages of his appliance in the National Magazines and publishes his own book of recipes and instructions. This form of publicity benefits the gas companies as much as it does the manufacturer and should receive the support of the companies even at an increased price for the appliance. Such ranges should be given a prominent place on our salesroom floors.

Our solicitors should have at least some idea of scientific cookery and of proper cooking temperatures. They should be thoroughly posted in the comparative costs of gas and electricity, and have an answer to every claim that the electric man can make. A well illustrated handbook containing in a concise form all this information is an invaluable aid and a little money spent in this way is more than repaid in results.

For instance, the electric salesman makes great claims for the possible automatic features of his range. How many of our salesmen are aware that there is a gas range on the market which is not only just as automatic but turns out as evenly cooked food as any electric range? The adoption of the automatic principles on any range is a matter of taste and has something to be said both for and against it but a clear illustration of this or some similar range should nevertheless be in every solicitor's handbook for use should occasion arise.

Lastly, and most important. Let the American Gas Institute

appoint a committee of representative manufacturers and new business men together with at least one domestic science expert to formulate the best methods of carrying out various processes on the gas range; to develop an appliance best adapted to the purpose and to issue publicity material to be utilized both nationally and by individual companies.

Conclusion.

Our object from the commencement of this paper has been to show by a series of unbiased and many times checked tests how the cost of gas and electric cooking compare, and the results show a saving of more than 60 per cent. in favor of gas.

There are, however, many consumers to whom this difference of cost means little and convenience everything, and it is these consumers that we are about to lose unless we realize at once that the appliances we are at present selling are neither as efficient nor as convenient as they might and should be.

Further our publicity methods with few exceptions compare unfavorably with those of any other industry representing an equal amount of capital.

Both faults are easily remedied if the members of the American Gas Institute will only combine to set an example of enterprise and true optimism to the industry as a whole.

The Chairman: Gentlemen, you have listened to a very interesting and a very carefully prepared paper. All the experimental data was very carefully taken, and it is unfortunate we were not able to read the paper in full and that it was not published earlier.

Mr. Edw. B. Myers (Philadelphia): (Written discussion communicated.) This paper on Gas versus Electric Cooking, by Mr. Bratton and Mr. Mantle, contains this statement, "From the standpoint of efficiency, the gas range of 20 years ago is the gas range of to-day." Such a statement is partially true, if by efficiency is meant thermal efficiency. However, it is to

be remembered that to the owner or user of the gas range, the one thing which is most important is the over-all efficiency. This over-all efficiency includes as a small part the thermal efficiency, but other things, such as simplicity, sturdiness, absence of need of continual adjustments, ease of operation and wide range of cooking ability constitute the major portion of this over-all efficiency. It is true, without question, that in those things making up the major portion of this efficiency there has been marked improvement. This is evidenced by the fact that to-day the ordinary gas range stands alone with its enviable reputation, and possesses this reputation not only with the masses, but with experienced cooks as well. Investigations are being conducted with the aim to improve the thermal efficiency of the ordinary gas range, and we believe the effort will be successful, but such success must not be at the expense of any decrease in the over-all efficiency.

Our experience in testing ranges over a long period has convinced us that absolute thermal efficiency tests are difficult to make and often misleading. In this opinion, we concur with the authors of this paper. We have recently made a lengthy test to determine the relative thermal efficiencies and other relative efficiencies of several gas and electric ranges. This test was conducted by three expert demonstrators and consisted in the cooking of some 85 meals, each sufficient for four persons in such a manner that on each range was cooked the same meals in identically the same way. This number of meals allowed the cooking of practically a week's meals on each range. The energy supplied to the oven and the top surface was measured separately in the case of both the gas ranges and the electric ranges. In this manner we were able to obtain the various relative efficiencies of all parts of both ranges. These tests show that to do the same work on the top surface of the electric range there was required but 64 per cent. of the energy necessary to do the same work on the top surface of the gas range. In oven work, the electric range consumed but 23 per cent. of the energy required by the gas range. In comparing the total energy (oven energy and top

surface energy) it was found that to do the same work in identically the same way, the electric range required but 35 per cent. of the energy required by the gas range. When one, therefore, considers carefully that in top surface work the electric range is slightly more efficient than the gas range, but that in oven work the electric range is a great deal more efficient than the gas range, it is evident that the total thermal efficiency will depend largely upon the percentage of work done in the oven, which is the most efficient part of the electric range.

Expert cooking demonstrators used efficient methods in their work and utilized to the best advantage all available energy. The same methods were used with electric ranges as with gas ranges, and it was found that in the case of the gas range 72 per cent. of the total energy had been expended in the oven and the balance, 28 per cent., had been expended on the top burner surface. The electric range, however, had consumed in the oven 47 per cent. of the total energy, and the balance, 53 per cent., had been consumed on the top burners. This difference is readily explainable because of the greater relative thermal efficiency of the electric range oven when compared to the thermal efficiency of the top burner surface of the electric range. To determine what percentage of the gas used in the average gas range under actual conditions is used in the oven and the top burners, several consumer's ranges were connected so that the gas might be so metered. We found that over an extended period fully 70 per cent. of the gas was used in the top burners and the balance, 30 per cent., was used in the oven. The average consumer uses the oven considerably less and the top burners considerably more than was the case in our test.

Therefore, while our test showed that the electric range, to do the same work, used but 35 per cent. of the energy used by the gas range, we have calculated that in the hands of the average consumer, the electric range would have used 55 per cent. of the energy used by the gas range. Having these relative thermal efficiencies in mind, relative costs may be ob-

tained, using the prevailing unit cost of electric current and gas. For example, cooking as carried on by these demonstrators in our tests, using economical methods whereby 72 per cent. of the total energy was used in the oven of the gas range, proves to us that 3-cent current is equivalent to 600 B. t. u. gas at $1.82 per thousand. It is not to be supposed, however, that the average user, or even those fairly well trained in cooking operations, will exercise the same care used by our demonstrators, and therefore will be unable to use electricity at anything like this efficiency. If the electric range is used as we have found the gas range to be used, that is, 75 per cent. of the total energy used in the top burners, we would find that 3-cent current corresponds to 600 B. t. u. gas at $2.83 per thousand.

The question of time necessary to complete cooking operations is also a matter of importance. The electric ranges are much slower in their work than the gas ranges. Top surface work took 45 per cent. more time to do on the electric range than on the gas range; broiler work, 50 per cent. longer; and baking work, 13 per cent. longer. Taking the average of 42 tests, it was found that for all operations, or the general operation of the range, that the electric range took 30 per cent. more time to complete the work than did the gas range.

In conclusion, we wish to say that we have yet to see any electric range which can compare favorably with the ordinary gas range when considering wide range and flexibility of cooking scope, variation of heat control, quickness of operation, and general cooking results. These conclusions have been arrived at over numerous and lengthy tests made by expert cooking demonstrators whose duty it was to search for the good points of the electric range and enlarge upon the disadvantages of the gas range. This contrast, moreover, will be still more strongly brought out when the electric range gets into the hands of the average person not so well versed in the science of cooking. We wish, however, to bring out forcibly the greater thermal efficiency of the electric range, with particular emphasis on the thermal efficiency of the oven of the

electric range. The manufacturers of gas ranges should realize these conditions and be guided accordingly.

THE CHAIRMAN: Some time ago a consumer, of a certain city, told me an electric solicitor was trying to sell her an electric range, and asked me what I thought about it. I told her to ask him to give her a list of ten consumers who were using the electric range to the exclusion of both gas and coal. She is still waiting. There were none.

MR. E. C. JONES: This paper was written by one of the live men of the northwest, Mr. Bratton; and he read a similar paper along the same lines before the recent meeting of the Pacific Coast Gas Association at Santa Barbara, and we appreciated it so much that we awarded him a gold medal.

It shows the drift of our business; that we now must study means of selling gas, rather than solely how to economize in the making of gas. It has been proven to our satisfaction that the electric range costs more money initially; it requires more time to do its work, and there has never been any question about the extravagance of the electric range.

We have economy and time in our favor, and there is nothing so valuable to Americans to-day as time. I look upon the gas and electric cooking appliances as I do upon the old story of Cinderella. I have always considered the electric range, with the money back of it and the flashy advertising of it, as the rich, well-dressed sisters of Cinderella, and the gas range with its true merit and economy based upon right principles and which I believe is the only way to cook or heat, as poor little Cinderella in the ashes of the fireside. But if you will, go back and remember what happened to Cinderella, with her crystal slipper and the Prince. She came out all right in the end. And it only rests with the gas men of to-day to show the world what can be done with gas.

Now, why don't we do it? Why should electric companies promote the sale of electric appliances and have full-page advertisements in the *Saturday Evening Post*, and our monthly magazines, and the gas man puts in a little squib in the paper and begrudges it, and says, "See your dealer."

Now, what consumers of gas in a community have a dealer? Who here knows where to buy a gas mantle or a gas range, or have a bit of repairing or plumbing work done in his native town? Silence!

The gas company must be morally responsible for its product up to the time it is converted into products of combustion, and the day has come when we will be held responsible for those products of combustion.

It means advertising. It means demonstration, and it means follow-up, and the gas range means as much to the gas man as his meter or his holder; it is the essence of his business.

Mr. H. C. Blackwell (Davenport, Iowa): The gas companies are apparently on the defensive once more. It is my belief that those of us present in the room to-day, who are employed by combination plants, are better able to appreciate the value of a discussion that might result from gas versus electric cooking, than those who are employed by either a straight gas company or a straight electric company.

For the company that I represent, we have tried to analyze the matter of electric cooking very carefully. We have plotted a great many curves showing clearly how the station load of both our gas plants and electric plants fluctuate and these curves show that the peak load at our gas plant comes almost identically at the same time as the peak load of the electric plant. The peak load on the gas plant is brought about to a large extent through the cooking load and it seems to us that if we endeavor to secure a large amount of electric cooking business, we would simply eliminate a corresponding amount of gas cooking business, since there are very few persons in our judgment in a community, who are now using other methods of cooking than gas, who would consider electric cooking.

It is, therefore, hard for us to make up our minds to spend additional money in power-plant equipment, sub-station equipment and distribution lines in order to take on the business brought about by electric cooking, simply to have this business removed from the gas distribution system.

We are advised by appliance manufacturers that the electric cooking load does not come on the peak load, since most of the work is done on stoves built along the lines of fireless cookers and that these cookers have to be brought up to temperature earlier in the evening than that time at which the annual station peak load comes on.

A great many low electric cooking rates are established through glib-tongued salesmen representing the various manufacturers of electric cooking devices. These men are necessarily trained to talk the advantages of a low cooking rate in order that they might sell the appliances, and to explain to the electric light and power companies the great advantages obtained through securing electric cooking business and also to tell how many other companies have installed these rates, and in a great many cases they succeed in securing the promise of the central station manager to install a low cooking rate, and frequently this comes about, not through the station manager investigating the merits of electric cooking or even the cost of this energy delivered to the electric range, but simply because some one else had done it.

There is no question that the morning meal and the noonday meal cooked by electricity will be off the peak and it is possible that the evening meal to a certain extent might be cooked off the peak, but in making a low rate strictly for cooking purposes, it is apparent that we are inviting rate troubles since it will become necessary to explain why electricity delivered at the same time for cooking purposes shall be sold at a lesser rate than electricity sold for lighting purposes, when both are used on the station peak.

It was embarrassing at times for those in the gas business, who used a double meter system, to explain why the gas measured through the cooking meter should be sold at a lesser rate than the gas sold through the lighting meter, and now that rate matters are being looked into so much more closely than they were in the past, it is much harder to explain and explanations become much more frequent than they used to, and it seems that the electric light man is simply bringing upon himself the

same burden that the gas man had a number of years ago with his double meter system.

Gas companies have been successful during the past couple of years in securing a large amount of industrial gas business and I believe that they are more apt to lose this class of business to the electric man than they are their gas cooking business. Enormous enameling oven installations have been connected to gas companies' lines and it is this class of load that is particularly attractive to the electric station, and this class of business can be offered an extremely low rate, which in many cases is more economical than by using gas at the rates which are available, and I feel that a large amount of this business is going to be lost by the gas companies to the competing electric companies, but rates that the electric companies might be able to make for the electric range for cooking purposes in the ordinary household are such as will not produce cheaper cooking than the normal gas rate, and I can, therefore, see no reason why we, as gas men, should feel at all concerned regarding our gas cooking with the exception of the very small percentage of those interested in the electric way irrespective of cost.

There is no question that there is going to be considerable publicity given to electric cooking and such organizations as the Society for Electrical Development will distribute enormous amounts of literature pertaining to this subject. This society is very active and, without a doubt, will promote during its so-called "Electrical Prosperity Week" from December 2nd to December 9th, a certain amount of electric cooking.

I feel that the electric companies in making a special electric cooking rate are subjecting themselves to question and criticism, as well as regulation by city councils or city or state commissions. It has always been the claim that rates were based to a large extent on the energy used during times of peak load, and, of course, if it is possible to show that electric cooking is not done on peak load, then the matter of explanation becomes much more simple.

Mr. W. R. Putnam (Salt Lake City): (Written discussion communicated.) The authors of this paper in discussing the method used by electrical people in presenting the advantages of electric ranges have the following to say:

"Unfortunately this policy has not been followed by the salesmen and demonstrators of the majority of the electrical supply companies and it is high time that some concerted action was taken to publicly refute the exaggerated and even ridiculous statements which are being made to thousands of people daily."

"To the gas man the arguments presented above are merely ridiculous, but are they so to the general public? This question is a pregnant one and until the gas companies realize that their consumers and prospective consumers have to be educated to the point at which they can place true value on statements such as those just cited the electrical companies will continue to gain our consumers."

Undoubtedly many of the enthusiastic promoters of electric cooking are making unwarranted claims for this use of electricity; however, the authors of this paper make just as fanciful claims in favor of gas cooking and the writer does not believe that it is fair to the electric side of our combined industry to allow these statements to go unnoticed. The writer refers to the conclusion reached in the analysis of the claims made for the electric range, particularly the statement on page 790 that: "Gas in general use costs 68.8 per cent. less for the same results than electricity in the latest type of range, the figures being based on $1.00 gas and 3-cent electricity;" also the statement in the conclusion on page 798 that: "The results show a saving of more than 60 per cent. in favor of gas."

The gas man is undoubtedly going to receive considerable benefit from the activity of the advocates of electric cooking, as it will result in his increased activity and sales of gas for the same purposes; however, the gas man must realize that the "pot must not call the kettle black" and it behooves him to exercise the same care in his statements as he asks of the electric man.

In discussions of the development of electric cooking before electric associations the theory has generally been advanced that the rapid development of electric cooking would not interfere with present gas cooking business, as the easiest field for the electric range man is in territory now served by electricity and not served with gas and in competitive situations, the proportionate sale of either type of range would be determined by the respective commercial activities of the competing companies.

A broad view of this situation demands that we appreciate that the gas and electric business are each a part of one large industry, the ownership of which belongs to the American people and that attacks upon either branch of the industry by the other branch, results in as much harm to the side of the industry attacking as to the side attacked.

Mr. H. W. Peck (Schenectady): This is the most interesting paper before this convention, partly because so many of us are combination men. For the last two months and over we have in our house used electricity exclusively for cooking. We have been able to compare the results under practically identical conditions with the four months previous, having had the same cook, an exceptionally careful and capable cook, and the same number in the family.

It is true that the electric cooking is somewhat slower, but we can do anything on the electric range that we could on the gas range, and as we have used the gas range, the meats are undoubtedly better cooked on the electric than on the gas range. Possibly by a different use of temperature, as suggested in the paper, we could have accomplished equally good results with the meats on the gas range.

As to the cost: I have had a separate meter on the gas range from that on the water heater supply. It cost us an average of $2.40 a month with gas. For the past two months it has cost us $3.45 a month for the electricity; 3-cent electricity as against $1.00 gas, an increase of 44 per cent. for the electricity over gas; or, in other words, 3-cent electricity being

equivalent to $1.44 gas, which compares very favorably with previous remarks which were made.

I do not think that the theoretical tests brought out in this paper amount to very much, because they are practical conditions we are up against—just as in the matter of lighting. The electric bills for lighting will not be higher than the gas in proportion to theoretical cost, partly because of the convenience of turning the electric light on and off, partly because less light will be used.

If the electrical men will emphasize the care that can very easily be taken with an electric range, and thereby get their customers to use more care, with greater economy, why they are that much ahead; and what the people look at undoubtedly is the question of the bill at the end of the month.

I do not quite agree with Mr. Jones, that time is the essence with Americans. I think that health and quality more than ever are being considered with us ahead of time.

Mr. E. C. Jones: Did you ever try them on an excess fare train?

Mr. Peck: I expect to to-morrow. (Laughter.) I might also mention, as far as health and safety go, that I am taking one road in preference to another because of its record for safety.

There is one detail which was not mentioned, and which is really quite important, in the use of the electric range, particularly with the cast-iron top burners, that it is often necessary to buy a complete outfit of new cooking utensils. If the pots and stew pans that you have been using for the last 5 or 6 years are somewhat rounded on the bottom, you will find that they are very inefficient on the electric range. You should buy a new set of utensils with flat bottoms. It may be that the test on page 784 was used with a rounded bottom sauce pan.

On page 785, the reference to the fireless cooking feature is a little too strong, I think, in view of the much greater convenience of having the fireless cooker feature incorporated as the regular part of the electric range; also of the additional

amount of heat taken to heat the soapstone or cast-iron plate that is commonly used in the gas fireless cooker.

With reference to the automatic range, I think that point is very well brought out, in view of our experience in Schenectady, of a large number of customers appreciating very much the gas range with the insulated oven and automatic features. I have heard them criticized at this convention somewhat, but our experience with them, possibly with select customers, has been very satisfactory.

There is one other element in favor of the electric range which appeals to me—two of the five people in the family being children—the matter of safety. They are rather prone to run into the kitchen whenever they get a chance and turn on the gas cocks, which is certainly dangerous. The electric switches are very much more difficult to turn on, and so far they have not even attempted to do it. They may, but there will not be the danger. There will be waste, but not the danger from turning on the electric switches.

I hope you will pardon me, in this discussion for speaking in favor of the electric range, but it is for the purpose of bringing out further discussion.

Mr. John B. Redd (Jersey City, N. J.): I would like to ask the gentleman a question before he takes his seat: What is the difference in amount invested in your gas and electric ranges, and what is the difference in the upkeep or maintenance cost?

Mr. Peck: I do not recall that there was any maintenance during the 4 months with gas. It was not a new range at the beginning of the 4-months' period, one that I have been using about 5 years, and the maintenance, of course, we all know is very light. On the other hand, there has been no maintenance during 2 months on the electric range, and I do not anticipate that there will be any, in view of the present attitude of the manufacturers, that if a top plate burns out they will replate it at very favorable terms.

Mr. Redd: Is that a special price to the gas and electric people or is it the regular retail price to your customers?

MR. PECK: I have been told that it was that to the consumers. In the 8 or 10 months we have not had any of the parts burn out yet.

THE CHAIRMAN: The last speaker spoke of the danger of children turning on gas at the gas range. It would be very interesting if some one would give any data as to this danger. In 20 years of my experience, I do not know of a single accident from this cause.

I would now like to take care of some of the committee reports.

REPORT OF THE COMMITTEE ON DISTRIBUTION.

The report of the Committee on Distribution, of which the speaker is Chairman, was originally intended for the Technical Committee. It is a plea for the standardization of materials and methods, and was printed in full in the Gas Institute *News* for May. It will, therefore, be unnecessary to take up the time of the meeting to read it at this time.

The report of the Committee on Distribution Standards has been printed and accepted and acted upon by the Board of Directors, as has also the report of the Committee on International Uniform System of Pipe Threads. They are unable to do anything this year on account of the war.

The report of the Committee on Supplying Large Buildings with Gas, was also acted upon by the Board of Directors, and there is one short discussion of it by Mr. Walton Forstall, which I will ask the Secretary to read.

REPORT OF THE COMMITTEE ON SUPPLYING LARGE BUILDINGS WITH GAS.

During the year 1913, there was appointed by the American Gas Institute the Committee on "Piping Large Buildings for Gas." The Chairman was abroad at the time this Committee was appointed and did not return until after the Institute meeting had been held, and a brief progress report was made at the 1913 meeting by the Acting Chairman, Mr. W. J. Serrill. Early in 1914 the work was actively taken up, and at the

meeting of the Institute in October, 1914, the Committee presented a voluminous report which was intended to give in detail the various reasons for, and arguments in favor of providing adequate piping systems in large buildings. This report dealt with the subject at considerable length and included much data that had been collected from various parts of the country. It concluded with the following definite recommendations:

1. Newspaper, architectural and building magazine and street car advertising giving in a compact, explicit and attractive form the arguments for piping large buildings for gas. These advertisements would reach the architects, builders and owners in a general way and attract their attention and should contain the offer of free expert advice in piping and installation work by the gas company.

2. The maintenance of a staff of engineers or men capable of giving this information to the architects, builders and owners.

3. The circularizing of all architects with an attractive booklet showing the many uses of gas in all fields, similar to the "Gas Equipment of the Home," issued by the N. C. G. A. This should be gotten up in an attractive manner with an appearance that would make certain of its being read and not thrown away on receipt. It would be well to enclose in this booklet a pamphlet giving concise reasons for piping large buildings for gas and offering again free service of experts of the gas company.

4. The maintenance of a staff of men whose sole duty is to visit architects, owners and builders of new buildings in an attempt to interest them in the gas piping of the same. These men should be in close touch with all new building operations, both contemplated and under course of construction. This can be accomplished by using any of the various building

report agencies who prepare reports on all building operations, giving location, owner, architect, contractors, class of building, etc., and progress of work. The Dodge Report System is typical of this work. These men should be sufficiently informed on the advantages of gas in all its uses and the cost and method of piping buildings to be able to talk intelligently and convincingly on these points. It would be well also if these men were closely connected personally with the building and architectural world.

5. The education or influencing of the plumbing and contracting fraternity by circularizing, personal interviewing or general educational work, in an effort to induce them to recommend adequate gas piping in all cases. This seems to your Committee to be a very profitable field and one that will undoubtedly produce productive results since the plumber and contractor should easily be convinced of the need for gas piping in large buildings and easily induced to lend their aid with the architects, because it is to their personal interest to secure as much work as possible in all building construction. Your Committee further believes that the plumbing and contracting profession once on the side of gas piping can lend considerable weight in presenting the case to the architect and builder.

6. The use of a careful and intelligent follow up system in all this work.

Following the presentation of its 1914 report, the Committee was reappointed under the title, Committee on "Supplying Large Buildings with Gas," and its instructions were to consider the subject from the broad standpoint of supplying large buildings with gas in addition to the matter of the piping of such structures. While this was done to a certain extent in its original report, it was felt that the information bearing upon general supply might be amplified to advantage. It was

also asked that there be presented a more definite idea of the booklet proposed for distribution to architects and builders. Therefore, at the 1915 meeting of the Institute, the report presented by the Committee included a synopsis and table of contents of a booklet such as would be suitable for distribution to architects and builders, designed to set forth the advantages of gas supply for large buildings; the necessity for piping such structures for gas; and to provide data and information relating to the gas supply for those interested in the erection of buildings of this class. A great deal of the material used in the Committee's 1914 report was to be included in the booklet—some portions in condensed form and others amplified, where desirable. The table of contents will be found in detail in the Committee's report.

The appointment of the original Committee and its subsequent activity was due to the increasing belief that the promotion of the utilization of gas has suffered through the erection of large modern buildings of the office, loft and similar types, primarily because in many such structures no provision for the use of gas has been made. Built upon sites formerly occupied by buildings in which gas had many applications, the so-called modern structure, housing many times the number of tenants that had occupied the original building, proved a very limited field for the use of our product; and the first obstacle to overcome in the attempt to correct this condition was the tendency on the part of architects, builders and owners to omit gas piping systems from such buildings.

The reports already presented by the Committee indicate clearly that there still exists a demand for gas in these buildings for many purposes; that the possible applications of gas to the uses of tenants of such structures is increasing; that the cost of providing the necessary piping system to supply these demands is comparatively negligible; and, that the condition complained of is principally due to the lack of activity on the part of gas companies in compelling the recognition of the advantages of and demands for gas supply, and further, that where proper activity has been brought to bear upon the

situation, the results obtained have fully justified the effort made.

It has been the effort of the Committee to present their findings in a way that will result in greater interest and activity on the part of the gas companies in this important matter.

The booklet now under discussion is but one of the recommendations made by the Committee in its 1914 report. It is not believed that by merely printing and distributing such a booklet, the desired results can be obtained. Such a publication will be expensive, and unless its distribution is followed up aggressively by local companies, your Committee doubts if it will be of sufficient value to warrant the expense.

There is much yet to be done by companies in presenting convincing arguments, facts and data to architects, builders, plumbers and renting agents, and in systematically following up new building operations along the lines recommended by the Committee in its 1914 report. This report contained much information and data that would be very useful for this purpose. Much can be done with the real estate interests, managing these large buildings, that will be beneficial and will assist in securing the piping of future structures, such as—the inclusion in advertisements of rental advantages of each such building in the newspapers, periodicals, trade journals, etc., the statement that adequate gas supply is provided; the incorporation in the promotive and descriptive booklet, gotten out by these interests for all such structures, of data and information on the equipment of the building designed to furnish the necessary gas supply. It is felt that very profitable work can and should be done along these lines. There is also the opportunity for the Institute, as a body, to establish closer relations with the architectural profession and to attempt to secure their interest in the matter by having papers read or lectures delivered before architectural meetings, and by inviting representatives of the architectural societies to be present at the meetings of the Institute, and through any similar activity that may be practicable.

The Committee's 1915 report was adopted and the Com-

mittee has been reappointed, yet it has received no definite instruction as to what is expected of it. The preparation of the booklet involves an expenditure which we are not prepared to accurately estimate. In any event, it could not be proceeded with until the Standard Housepiping Specifications are completed and adopted, as it was intended to make these a part of the booklet. This, of course, precludes the possibility of completing the work this year.

Your Committee believes that the present need is not so much for a booklet as for the awakened interest and aggressive action of the gas industry, and the intelligent use in local situations of the information already provided.

Oscar H. Fogg, *Chairman,*
J. D. von Maur,
James S. McIlhenny,
Wm. J. Serrill,
J. Arnold Norcross,
D. E. Keppelmann.

Mr. Walton Forstall: (Written discussion communicated.) The six recommendations reprinted from the Committee's 1914 report, should be taken to heart by each gas company, and followed out as far as possible. At the same time, the Institute has its own duty in the premises, and this involves the preparation of the booklet described in recommendation No. 3. It is no credit to the industry as a whole that this publication still should be lacking, and should wait, like so many other kindred matters, upon the proper organization of the gas industry in this country—an organization which will, for the first time adequately mobilize for the common good, the great resources of the business.

The Vice-President: I will call for the report of the Committee on Electrolysis, Mr. Gould, Chairman.

REPORT OF COMMITTEE ON ELECTROLYSIS.

The Committee on Electrolysis makes the following progress report for the year 1915-16.

This Committee attended a meeting of the American Committee on Electrolysis, formerly called the Joint National Committee on Electrolysis, in New York on June 30, 1916, where the day was spent in discussing the second galley proof of the Preliminary Report.

The meeting then adjourned to allow each member further time to examine the report and to submit to the Publication Committee any desired changes in this report. These suggestions were incorporated as far as possible in the third galley proof. Copies of the corrected proof were sent to each member and on September 21 and 22 the Committee again met in New York and devoted five sessions to the careful consideration of the report in detail.

The report as amended at these meetings was finally unanimously adopted by the Committee. There were present 20 members, including the three representatives of the American Gas Institute, and also two representatives of absent members.

The national associations represented on the American Committee on Electrolysis are the

American Institute of Electrical Engineers.
American Electric Railway Association.
American Railway Engineering Association.
American Telephone and Telegraph Company.
American Water Works Association.
National Electric Light Association.
Natural Gas Association.
American Gas Institute,

and one representative of the Bureau of Standards.

It was hoped when we adjourned that the final proof paged, and with inserts, would be ready so that each member of the Committee could receive two copies and ten copies for each Association.

This report is a preliminary report, which confines itself to statements of facts, without any recommendations. On its title page appears the words "Printed, but not Published."

It is understood that the report will not be published until the several Associations have approved the report.

A new Sub-Committee with one representative from each Association has been selected to continue the work and draft recommendations for a report on the Prevention or Mitigation of Electrolysis.

Prof. Albert F. Ganz has been selected as the representative of the American Gas Institute on this new Committee.

Our Committee regret that it is unable to submit the preliminary report at this time, but we urge that the report will be given early attention after its receipt, as the agreement between the Associations represented will prevent its publication until approved by all the Associations.

We believe there is valuable information in this report which should be published as soon as possible.

Yours respectfully,

J. A. Gould, *Chairman*,
Albert F. Ganz,
J. D. von Maur.

SUPPLEMENTARY REPORT OF COMMITTEE ON ELECTROLYSIS.

A meeting of the American Committee on Electrolysis, formerly called the Joint National Committee on Electrolysis, was held in New York City, June 30, 1916, and a Preliminary Report was discussed; later changes were substituted and incorporated in a further report which was discussed at a meeting Sept. 21 and 22. The report was gone over in detail. The report as amended was finally unanimously adopted by the Committee. This is a preliminary report and will not be published until the several associations have approved the same.

A new Sub-Committee has been selected to draft recommendations for a report on the Prevention and Mitigation of Electrolysis. Your Committee recommend that this Sub-Committee, with the same membership, be continued the coming year, in order that this Preliminary Report may be submitted to the Technical Committee by the same men who have worked on it since its inception.

It is desirable that this Preliminary Report, which states only facts without any recommendation, be submitted to the Directors for its approval as soon as possible.

THE CHAIRMAN: You have heard the report of the Committee. This report has already been submitted to the Board of Directors. What action would you like to take?

MR. A. E. FORSTALL: Mr. Chairman, I move that the Distribution Section recommend to the Institute that the Directors be authorized to act upon the Preliminary Report of the American Committee on Electrolysis, formerly called the International Committee on Electrolysis.

THE CHAIRMAN: Do I hear a second to that resolution?
(The resolution was duly seconded.)

THE CHAIRMAN: It is moved and seconded that this Section recommend to the Institute the resolution which has been read. All signify by saying aye; contrary no.
(The motion prevailed.)

THE CHAIRMAN: I will now call for the report of the Committee on Nominations for Vice-President of the Distribution Section; Mr. Gould, Chairman.

MR. J. A. GOULD (Boston, Mass.): The Committee appointed to nominate three candidates for Vice-President Distribution Section for the coming year have selected

Mr. George T. Macbeth,
Mr. R. B. Duncan,
Mr. B. F. Pelton.

Respectfully submitted,

J. A. GOULD, *Chairman,*
ALFRED A. TREADWAY.

THE CHAIRMAN: You have heard the report of the Nominating Committee. You understand that the report of the Nominating Committee (if adopted by this Section) will be given to the Nominating Committee which the incoming Board of Directors will appoint next year, and they must nominate

one of the gentlemen chosen to-day for Vice-President of the Distribution Section one year hence—according to Section 31 of the Constitution. What is your pleasure?

Mr. G. H. Waring: I move that the Secretary be instructed to cast the ballot in favor of the recommendation as read.

(The motion was duly seconded.)

The Chairman: I declare these gentlemen the nominees for next year.

It is now a quarter to twelve, and I do not think we could do justice to the report of the Meters Committee or to the paper on Industrial Appliances. I judge it would be better to adjourn. The Chair will be guided by your action.

(On motion duly made and seconded, a motion to adjourn prevailed.)

(An adjournment was here taken to 9.30 o'clock A. M., Thursday, October 19, 1916.)

DISTRIBUTION SECTION.

Second Section, Thursday, October 19, 9.30 A. M.

Mr. J. D. von Maur, *Vice-President,* presiding.
Mr. G. I. Vincent, *Secretary.*

The Chairman: Mr. E. B. Myers will read the paper "Industrial Appliances," prepared by Mr. S. Tully Willson.

INDUSTRIAL GAS APPLIANCES.

Because of the thousands of applications of gas to industrial purposes this subject is a very broad one and for this reason must be handled in a general way.

The theme might be approached either from the ultimate appliance in use, or from the point where the greatest interest would naturally be localized.

The gas men have the most to gain by the advancement of this propaganda, and hence should be responsible for its genesis.

Whatever your connection with the gas industry, from financier to office boy, the success of your company will increase your personal success.

Competition.—The successful business develops competition. The gas business has been successful, and so has the competition. You once competed with coal oil or kerosene and practically eliminated it from the lighting field.

Then electricity seriously threatened you and the incandescent mantle gave you another lease on life. However, electric lights are very popular.

Then you took up the problem of domestic cooking, and this new field largely relieved your worries over the lighting which the electric companies were doing. Now the electric wedge has entered here also.

It is very easy to produce figures which will show how absurd it would be to use electricity for cooking when gas can be had, but you can do this with the lights too. When elec-

tricity first encroached upon your lighting, the difference was about the same, so do not say "it can't be done."

Now is the time to find and secure every customer for gas that you can. In the industrial field you have a big lead over electricity, but this lead will not be held without an effort.

Managers' Responsibility.—The general manager, who felt the responsibility for the advancement of his company, long since employed solicitors for house piping and fixtures, and later for ranges and water heaters.

Domestic Salesmen.—These men had, at most, half a dozen articles to sell. Most of their customers were more or less familiar with the goods and a low-salaried peddler or order-taker produced fair returns.

Industrial Business.—The industrial business is a different proposition. It has been before the Institute since its inception. You have been told frequently of the difficult problems met, and of the importance to you of solving them.

Competent Salesmen.—When you have difficult and important problems to be solved your good judgment should prompt you to put them in the hands of competent men, and competent men are seriously lacking in the industrial end of the gas business.

Many men have been developed or have worked and studied hard enough to become good industrial gas salesmen; then they were discovered by some manufacturer, and naturally went where they were appreciated.

Future Assured.—The future of industrial gas is assured and gas men are waking up to its possibilities, but it takes some men a long time to get out of bed after they are awake.

Expansion Versus Saving.—If it is your wish that your properties should grow rapidly, that your plants should pay, you will make a much larger showing by increasing your rate of growth than by reducing your operating expenses 1 or 2 per cent. over last year. If you will put good salesmen and engineers on your industrial problems the returns will continue and the seed will grow year after year.

The industrial business may eventually produce more than 75 per cent. of your revenue.

It is the best form or preparedness to get it now; it is a very big and substantial buffer to fall back on.

No man can foretell the future with certainty, but we know that the industries must have fuel and that gas is being favorably received. We should also realize that it may not always be possible to retain a firm hold on gas lighting and cooking for the competition appears to be increasingly aggressive.

Industrial business awaits every gas company large or small in every city or village.

Fair Play.—If you will determine fairly in your own minds just how much you can afford to pay to get this revenue, basing your estimate, we will say, on what it has cost you in the past to get the domestic consumption, and then, without hedging, pay it, you will find that you can get capable men who can get the business and that you can keep them.

Responsibility.—As suggested a moment ago, the success of the industrial fuel business rests with the management. The responsibility lies first in the American Gas Institute members, and after that in the National Commercial Gas Association members.

Results Expected.—Your directors and your stock holders expect you to get the best possible returns from your properties and your commercial manager, if you have one, is your employee for whom you are responsible.

The business and the revenue are there and this fact is much more important, to my mind, than the engineering details which are so numerous that many volumes would not cover them.

Industrial Problems.—The industrial problems are being taken up now in a systematic way. Pamphlets have been published covering a number of trades or appliances. Their purpose is to assist you in securing more business. Have you encouraged or supported this work? Has your company, or rather have your men done their share?

Every success in every city helps all. Some one must set

the pace to be sure, but all of you benefit, the general manager more than the commercial manager and, gentlemen, if each of you endorse the work, and encourage your men to do their part toward advancing the general knowledge of the industrial fuel end of the gas business, that end will soon become the foremost end—the most important because the most remunerative to the stockholders.

What I have said thus far, is only a synopsis of what I feel called upon to say every time I have an opportunity of addressing gas men.

Having perfected our organization let us take up some of the problems which have to do with cost of production and rates.

Gas Quality and Rates.—Some cities are still required to supply gas of high candle-power, consequently they are handicapped to some extent in securing certain industrial business, because their cost in the holder is a few cents higher than is necessary.

Straightening your load curve by selling industrial gas will much more than offset this difference in your monthly balance.

The candle-power standard is being reduced and is gradually disappearing, and whether you sell your gas by the million B. t. u.'s or by the thousand cubic feet, with a reasonable thermal standard, will not greatly influence your sales for industrial purposes.

Rich Gas.—A gas rich in hydrocarbons is not well suited to most gas appliances, especially atmospheric appliances. Such a gas requires more air for its combustion, and if delivered at low pressure will scarcely entrain sufficient air in the ordinary Bunsen burner to give a good flame and still not fire back. A gas of reasonably low B. t. u.'s per cubic foot will give greater satisfaction under the usual operating conditions of atmospheric burners than a richer gas.

Uniformity.—The most important consideration, however, is that the gas be always uniform in quality. A variation in either pressure or composition will alter the adjustment of all burners, and though blast burners are easy to adjust and are

usually closely watched, atmospheric burners as a rule receive little attention from the operators.

Hence, manufacturing conditions should be maintained constant, as this is more important to the consumer than a high calorific value.

A reasonable calorific standard, by permitting the manufacture of a gas free from condensible hydrocarbons, will enable the plant operators to supply a nearly uniform quality at all seasons of the year.

Plant Expansion.—In increasing your manufacturing facilities it would seem to be good policy to install equipment with the ultimate object in view of supplying the kind of gas which will eventually be demanded. That is the gas which will cost the least per heat unit above 212° F.

There are very few industrial appliances which save the latent heat in the steam formed by combustion and eventually this will be a consideration.

Flame Temperature.—Another point of great importance is the flame temperature of the gas. Many industrial operations, welding for example, demand a high flame temperature, and when the work to be done requires a temperature approximating the flame temperature of the gas the efficiency of the operation will be extremely low. While a gas of higher flame temperature though of same calorific value per cubic foot would accomplish the work readily.

Combined hydrogen and carbon give a higher flame temperature than either hydrogen or carbon monoxide; and as a high flame temperature is essential for some operations, it is desirable from the industrial engineer's standpoint that the hydrocarbons (other than condensible hydrocarbons) in your gas be as high as is practicable.

Pressure.—The pressure at which gas is delivered deserves your most careful thought. Most of the atmospheric appliances require at least 2-inch water pressure for their proper operation, therefore this figure has been generally adopted as the minimum.

Higher pressures than this are certainly preferable, but

whether it is advisable to go to the so-called high pressure distribution solely for the sake of certain industrial appliances might be debatable.

Increased Efficiency.—Most atmospheric appliances which are used for the direct application of heat, will, if properly adjusted, show increasing efficiencies with higher pressures. This fact is well-known to apply to incandescent gas lights, but it is not so clear, perhaps, that it also applies to such applications as the top burner of a gas range.

If such a burner is designed to operate with gas at 2-inch water pressure and then is used at 6 or 10-inch pressure the results will be high capacity but no actual increase in efficiency.

To take advantage of a 10-inch water pressure the burner should have a reduced orifice and especially should the burner be placed closer to the vessel.

By adjusting the burner orifice so that the consumption at 10 inches will be the same as it was intended to be at 2 inches the flame will be shorter, which makes it possible to set the burner closer to a vessel without smothering the flame.

With a properly constructed burner it would also be possible to supply more air to the primary mixture which would reduce the size of the flame still further.

High Pressure Assured.—All appliances can be arranged to operate with high pressure gas and as the efficiency of many of them may be thus increased it would seem desirable from the industrial engineers' point of view to advocate high pressures—the higher the better.

It is appreciated that there are many other considerations than the appliances involved in increased pressures, such as cost of compression, main leakage, and the leakage from old and cheap fixtures and house piping.

The leakage problems can all be adjusted as they have been with natural gas, and the increase in efficiency might easily more than offset the cost of compression.

Gas Pressure Versus Air Pressure.—In order to obtain the burner pressure of the gas and air mixture, which is usual in

most blast appliances, it would be necessary to carry quite a high pressure on the gas. Positive blast burners operate with a tuyere-or burner port-pressure of 1½ to 2 inches water pressure.

This burner pressure is usually obtained by compressing air to about 1½ pounds and injecting it into the burner, the air drawing in the gas by a partial vacuum formed by the injector.

Theoretically this does not seem to be very efficient practice for if a burner pressure of only 2 inches is required on blast appliances and burners, and the gas is delivered at, at least, a 2-inch pressure, then it would seem only to be necessary to supply air also at 2 inches or slightly more pressure to accomplish this result.

It is this theory which has prompted the manufacture of fan blast appliances, and their success would seem to be sufficient evidence of the correctness of the theory.

It may be asked at this point why more appliances built on this principle are not available and the best explanation I can give is that it takes much time to construct all the variety of appliances to which this principle will apply.

Remember there are hundreds of styles and sizes to be made.

Back Pressure.—One danger which is met in the use of positive blast appliances is that of the tuyere or burner ports becoming clogged and the air blowing back into the gas line.

Though this is a real danger I do not believe it occurs so frequently in modern appliances as it has in some of the older types. It is more likely to occur in blast appliances of home-made design where the injector is not properly proportioned or the tuyere not well made.

Where there is any indication that such an occurrence is possible, "it is better to be safe than sorry," and a back pressure valve can be installed in the gas line, or else properly constructed tuyeres and injectors substituted.

Advantage of Low Air Pressure.—One of the great advantages of fan blast appliances is that no such danger exists

when they are used, as the air pressure is no greater and in fact is usually less than that of the gas.

Proportional Mixers.—It is also quite practical to mix the air and gas with a mechanical proportioner and then deliver the mixture to any number of heating units.

This system would seem to have many meritorious points.

The adjustment of the mixture is not dependent upon the operator of each appliance. He merely controls the amount of heat required. Hence any system which accomplishes this result is sure to increase the efficiency of the appliances as well as eliminate any possibility of the air being forced back into the gas line.

Selection of System.—The question of when to use the various systems often arises and is a very difficult one to answer satisfactorily.

China is usually fired with atmospheric burners and many operations requiring 2,000° F. or even more are sometimes accomplished with them.

In other cases blast appliances are frequently used where the maximum temperature required is less than 250° F.

The selection of the system to be used must usually depend more upon the appliances available which are built to accomplish the purpose desired than upon what seems to be the best theoretical method of doing the work.

Different manufacturers have developed their product from different view points. The appliance business is in its infancy and the main object has been to accomplish some definite result. So in purchasing or selling appliances it is necessary to keep in mind the main purpose for which the appliance is to be used and use the appliance which is known to produce the required results rather than one which, according to somebody's theory, ought to do so.

Heat Application.—A little further explanation of the application of the heat in the gas may be desirable.

The china kiln is fired with atmospheric burners because speed is not desired.

The kiln must not be heated too quickly, it must heat evenly

throughout and must cool slowly. It has considerable muffle surface for the absorption of heat and is well insulated.

A confectioners' furnace built for the manufacturing confectioner is equipped with a blast burner, though the highest temperature he cooks his candy to, is 340° F. This is because he demands the greatest possible speed for the operation, because speed in cooking increases his output per man and decreases his unit of floor space and overhead expense; also because some candies are inferior if cooked slowly.

The melting of small quantities of soft metal is easily accomplished with atmospheric burners, and yet blast burners are used in many cases.

Each cubic foot of gas contains a fixed quantity of heat and if wholly burned all of this heat is developed, hence the problem of the appliance manufacturer is principally that of the efficient application of this heat.

Complications in Heat Application.—In order to demonstrate the many complications which enter into the application of the heat from gas we will take up one of the oldest problems in some detail.

Let us assume that we wish to heat a closed living room in which several people are quietly seated.

We will also assume that 20 cubic feet of gas per hour would supply a sufficient number of heat units to keep the room comfortable if the heat were properly distributed.

First suppose we have a large gas fixture with lava tips sufficient to burn our required gas. We will place Bunsen burners on these and the result will be that the top of the room will be overheated and the lower portion cold. There is no radiant heat and all of the heating must be done by circulation and as the burners are placed high the circulation is largely in the upper half of the room.

If we change now to lava tips and the luminous flame, we will immediately see some improvement because of the radiant heat given off by the white hot carbon in the flame.

Then changing again to inverted incandescent lights with

reflectors, a marked warmth is felt beneath the lights as more radiant heat has been sent down where it is needed.

Still, most of our conducted heat is in the upper portion of the room and the circulation in the lower portion has only been improved slightly by the convected heat due to the radiation.

If we now put our Bunsen burners on the floor and eliminate the lights we find, after equilibrium is established, that the lower portion of the room is warmer than under the previous conditions because now we have complete circulation of all the air in the room, but still it will not feel as warm to the people as it might.

Let us next take a radiator with a large surface, preferably with a dark matte finish, and deliver all of our heat to this appliance.

We now have a maximum amount of radiating surface and therefore the minimum amount of hot flue gases passing directly to the ceiling. We also have a large quantity or volume of air heated by convection, rising to the ceiling and forcing the air which is there to a lower level. We are working with lower differences in air temperature and larger volumes, and hence obtain a more uniform temperature throughout this room and more comfort for the occupants.

Therefore the gas heater which most nearly approaches the hot water radiator in its action (not in its design or appearance) should be the most satisfactory.

Bear in mind that the steam radiator has less surface and a higher temperature than the hot water radiator and so theoretically is not so good.

Blast Burners for Space Heating.—Blast burners would be out of place for such work and still they are used quite widely for heating large ovens.

The reason is usually to save space as the heating units are much smaller when blast is used though no more heat is delivered or developed per cubic foot of gas burned.

The heating of japanning ovens involves as many more

considerations as have been applied to room heating so that only one point will be considered.

Electric Heating.—There has recently been some competition with electricity in the performance of this operation and a comparison of costs of operation should be of interest.

The first cost of electric equipment is much in excess of that for gas.

The upkeep also to date has been heavy though this expense may be carried either by the manufacturer of the electric equipment or by the electric company supplying current in order to retain the business.

There should be no question about the ability to accomplish the work properly with electricity, for heating units can be, even if they have not already been, designed to do this.

Hence the main item of interest is operating cost.

One kilowatt of electricity is equal to 3,415 B. t. u.'s per hour, therefore 5.69 cu. ft. of 600 B. t. u. gas per hour will equal the expenditure of 1 kilowatt-hour.

Assuming a gas heater with an efficiency of only 56.9 per cent. and an electric heater of 100 per cent. efficiency, then 10 cubic feet of gas would equal 1 kilowatt.

With gas at $1.00 per M, this would equal electricity at 1 cent per kilowatt-hour.

As a matter of fact very much higher efficiencies than this are obtained with gas and Mr. Treadway of Detroit has found in practice that only 8 cubic feet of their gas are required to equal the work of 1 kilowatt-hour of electricity for japanning work.

The electrical equipment requires considerable space for switchboards and of course very expensive wiring.

The life of heating units is short and on account of their high cost there is a natural inclination to supply the minimum of equipment, and therefore of heat. Poor ventilation of the electric ovens is quite usual.

There should be little difficulty in securing and holding all of this class of business.

Improved Appliances.—Industrial appliances generally are being noticeably improved. There are many ways and systems of applying the heat in the gas. Ways of saving some of the heat formerly lost and a general advancement in efficiency and practicability is quite apparent.

Radiant Heat.—The development and use of radiant heat in industrial appliances is finding an increasing range of usefulness and the efficiency of many appliances can be increased by its proper application.

Burners which develop radiant heat produce a higher differential temperature than blue-flame burners, and in addition can in most cases be placed closer to the vessel or material to be heated.

The result is an increase in the heat applied due to greater differential temperature. Radiant heat strikes right through inert and even comparatively cool flue gases and in addition there is a hotter application of the flame or flue gases due to closer proximity.

Preheating.—In addition some appliances have been equipped with preheating chambers in which either the air for combustion or materials being worked, may be heated by the waste heat in the flue gases.

The details of any one of these operations are worthy of a long article.

Published Information.—The National Commercial Gas Association has had published half a dozen treatises on the application of gas to specific purposes and have as many more in course of preparation.

These pamphlets are compiled by the various industrial men who have special knowledge on the subjects and it is my belief that they will be of greater assistance in familiarizing both the prospective consumer and the appliance salesman with the usefulness of gas in its various applications, than any other work which has been done heretofore.

They are not technical in form and the ambitious salesman engineer should absorb the information they contain and also avail himself of the special N. C. G. A. industrial fuel course.

Your greatest future gain in revenue undoubtedly lies in the sale of industrial gas. The gas appliance manufacturer is endeavoring to keep pace with the increasing demand, and as is the case with every new manufactured product, the quality will be improved with time and experience.

Your success is proportionate to your interest.

THE CHAIRMAN: Gentlemen, you have listened to a very interesting paper on a very broad subject; undoubtedly one of the most important in the gas industry. It is to be hoped that some day the Institute will consider the advisability of having meetings at which the entire time will be devoted to some one subject. A special meeting held during the year might well be entirely devoted to the subject of Gas for Industrial Purposes. Manufacturers of appliances, salesmen, rate and engineering experts should come together at such a meeting and, with nothing to detract their attention, consider this very important subject. The result, I believe, would be of immense benefit to the gas industry.

The National Commercial Gas Association has done much good work on this line. I do not believe the American Gas Institute has done its full share. Your discussion this morning should be a very serious one, and we should bring out as many points as possible.

There is a written discussion from Mr. V. F. Dewey, which I will ask the Secretary to read.

MR. V. F. DEWEY (Detroit, Mich.): (Written discussion communicated.) I believe more emphasis should have been laid on competent salesmen. Engineering and industrial problems are the basis of our work. Salesmen who are simply "order takers" do not make a proper foundation for continued success. The industrial salesman must be a trained man. Personally, I hesitate to employ a man in the Industrial Sales Department who has not received a technical education. To get educated and trained men of the type required we must make it worth while, both in pay and advancement.

Do not be afraid to spend a reasonable amount in experi-

mental work. It gives your men confidence in their work, and it is often the only way difficult problems can be solved.

At all times guarantee your work. A gas company that is not sure enough of its work to guarantee it will not get far with its customers.

Build an industrial sales department that will command the respect and confidence of the general managers and production engineers of your large industrial plants.

Do not be afraid to tackle the big and difficult problems.

Do not hesitate to discourage the use of gas where some other form of energy is better adapted and more economical, but be sure that such is the case.

I do not wish to depreciate the value of a small business and small consumers, but I do think many a sales manager has been too much "the man with the hoe" in the industrial end of his business, too busy grubbing about among the soldering iron heaters, blow torches, etc., to look up and perceive the immense business above him.

One other side of this question: Lower rates *versus* a good industrial department. Low rates by themselves will not get and hold industrial business. There are some industrial gas rates in this country that are too low and cannot be justified by an accurate analysis of financial and engineering conditions, and it seems apparent that the reason they were put in was that they would get certain business. To have put them in for this reason is an admission on the part of the companies that they are incompetent to organize and conduct a proper sales department. With a reasonable rate that will give reasonable returns on the investment, all things considered, a ½ cent per thousand expenditure made in developing and promoting a well organized industrial sales department will get and keep more business than a 5-cent per thousand reduction in rate without such a department.

THE CHAIRMAN: Mr. Dewey's success in Detroit is sufficient proof that he knows what he is talking about.

I see Mr. Treadway in the audience, and we would like to hear from him.

Mr. A. A. Treadway (Detroit): There is one point which I think should be emphasized, and that is in relation to the use of high pressure gas.

On page 825 mention is made of high pressure gas. There is also a statement as follows:

"The leakage problems can all be adjusted as they have been with natural gas, and the increase in efficiency might easily more than offset the cost of compression."

In our work we have found that with drilled pipe burners using gas supplied to the mixers at 1 pound, we can get the same rate of burning and same results as we had been getting with the blast system. The high pressure system has thus simplified to a great extent the problem of the supplying of heat to japanning ovens, because only one system of piping is needed; control of the one or more ovens can be had at one point and simple thermostatic valves may be employed. We have carried the idea further and expect to install a system using high pressure gas operating at 3 pounds per square inch to replace a blast system in a place where they have over twenty soft metal furnaces of a ton capacity each. The advantages gained will be simplicity of control, better combustion, and greater all-around efficiency.

We have not any more than touched the possibilities of high pressure gas. Through our efforts in Detroit installations have been made at St. Louis, Indianapolis, Ypsilanti, and Flint. It seems to be growing in popularity very rapidly.

In commenting on the second paragraph about the leakage problem, etc., we would suggest that the gas be compressed near the appliances to be used, as is the case, usually, when a blower is used in a blast system. Small gas boosters may be obtained and they may not be more costly than a blower, when it is borne in mind that only a small volume of gas must be compressed compared with the air necessary for any one job and only one system of piping is required. We believe that individual boosters for different jobs have many advantages, from a gas company's viewpoint, over compressing all the gas

in the distribution system and delivering it to the consumer at or above 1½ pounds.

In the paper there seems to be an idea that in using high pressure gas, it is necessary to boost the pressure of the whole system at the works to 1 or more pounds. That is not necessary nor desirable. In one case, good results may be had in operating with gas at a pressure of 1 pound at the burner and in another, 3 pounds and another, 5 pounds. So it would be obviously too expensive to get the results by compressing to the maximum pressure desired, at the station. By installing a small compressor, or gas booster, near the appliance, one can be chosen which will give the desired pressure and volume for that particular place.

I have in mind an installation using surface combustion burners, where they compress to 15 pounds per square inch. In Detroit, in most of our work so far we have only compressed to 1 pound; but it depends entirely upon what kind of work you are trying to do as to what the pressure should be, and the greatest advantage in this is its simplicity. All who have had experience with gas appliances know there are some troubles which it is hard to avoid. In the paper it was mentioned that 2 years burning closed the outlet, and the gas went around by another path. In foundries where they hire the cheapest kind of foreign labor, labor which cannot understand English, they seldom have the proper adjustment. One-half the time they turn off the air and let the gas burn with a yellow flame, and such other similar conditions. But we find with gas consumption that you get the same results, and it is as simple to operate as a gas range. One system of valves and a cock operating a number of different burners can be used with entire success.

Mr. Geo. S. Barrows (Providence, R. I.): Referring to Mr. Treadway's remarks on the subject of pressure gas, I was much interested during a visit to England a few years ago to see the very general use of pressure gas for industrial purposes. In London and Birmingham special mains

were laid for this purpose. At the Woolwich Arsenal, I believe no air-blast appliances were used, all using pressure gas. I was told by the various engineers that greater economies were possible because the operators had but one adjustment to make.

I was so favorably impressed that on my return I looked for an opportunity to make a similar installation. This came in an establishment using a large number of pressing irons. At first all went well, but as the gas orifices of the irons were minute because of the low consumption they soon clogged with lint and air-blast irons were substituted.

From other tests, however, I am certain that pressure gas appliances have a large field and one in which they are probably more easy and economical to operate than air-blast appliances.

Mr. E. B. Myers (Philadelphia): There is one phase of this subject which I believe has not been touched upon.

The hygienic effect upon workers of artificial lighting systems, whatever may be the source of energy, is receiving considerable attention by the Illuminating Engineering Society, and at the same time, by various municipal and state commissions and industrial boards. At the same time these various boards and commissions interest themselves in the general hygienic conditions of workrooms and factories, and it is the duty of the gas man to see that gas appliances are installed and operated so that they do not create a condition which may be criticised by such bodies.

The combustion of the gas should be complete at all times. Where there are a number of operators, each adjusting and using his own appliance, grouped in one or more rooms, many of the appliances are apt to be adjusted improperly. This condition not only makes for inefficiency in fuel consumption, but may vitiate the atmosphere by delivering products of incomplete combustion into the room.

We would suggest that gas men carefully investigate systems now on the market and in use wherein a perfect pre-

mixture of air and gas is delivered through one pipe to the appliance. In this system, a proportion of air and gas is determined upon, is fixed and is changed only by the person having the mixing apparatus in charge. There is nothing to adjust at the burner, since exactly the necessary amount of air for complete combustion is taken in as primary air. The operator may increase or decrease the amount of heat desired by operating a single valve. This in itself makes it easy to install automatic temperature regulators if so desired. There are many classes of work to which this system is particularly well adapted, and where installed will often increase the fuel efficiency and make for more hygienic conditions of the workroom atmosphere.

Mr. W. J. Serrill: This seems the proper place to read from the report of the Committee on Gas Fuel Appliances, the section on "Industrial Appliances."

(Mr. Serrill, reading:)

"Several factors are combining to bring the use of gas for industrial purposes into greater prominence and to encourage and warrant increased attention by gas managers everywhere to this branch of their business. These factors are: The cumulative educational effect on manufacturers of increased efforts of the gas men to introduce gas for industrial purposes; the increased efforts by gas appliance makers to meet the needs of every opening for the use of gas; the great development of factories and processes of a class suited to gaseous fuel; the rising prices of competing fuels, as oil and coal; the growing practice of gas companies to make graded rates to large consumers; and, last, to some extent, the stimulus of competition due to the strong and persistent efforts of the electrical industry to appropriate as far as possible this same field of industrial fuel.

"As gas lighting has been threatened by the successful competition of the electric light, so, in a lesser degree, is the electric furnace beginning to compete with the gas furnace. In some localities, the electric companies have made very low

rates for this class of service, rendering the electric furnaces, in such places, a real competitor to the gas furnace.

"An enormous outlet for gas consumption awaits the gas industry, provided it strives to obtain it now, and actually gains possession of it; but the industry must be alert. It is far easier to defend a ground already occupied than to recover it after it has been lost. Not only should great energy be applied now towards this end, but the best of service and latest of engineering methods should be employed in industrial installations. The services of skilled, experienced engineers should be adopted. Such gas companies as have no men of this type can get expert advice and special designs from several companies whose specialty is the designing and making of gas appliances for the industrial field. In some places, and for many purposes, it will be found necessary to establish low rates for gas used industrially over long hours and in large quantities. The gas man who proceeds on the above lines has every reason to take an optimistic view, and will achieve the success for which he strives.

"Special attention is required for that class of industrial installation, in which a number of operatives, each using his own torch or burning appliances, is grouped in one room. The tendency of some of the numerous appliances to get out of perfect adjustment, either accidentally or through ignorance of the operators, and consequently to deliver a modicum of the products of incomplete combustion into the room, thus vitiating the atmosphere, should be guarded against. In some cases, this condition has brought the use of gaseous fuel into disrepute. Gas men are advised to investigate the several systems now on the market, in which a perfect pre-mixture of gas and air is made and delivered to the operatives' burners. In this case, there is nothing to adjust or get misplaced at the burner, and perfect combustion is assured. Such pre-mixture systems must, of course, be provided with adequate means to prevent back-firing and explosion at the mixing machinery. These means are well developed at the present time."

This question of industrial gas is a question for the expert,

and none but the largest companies can afford to keep continuously in their employ the kind of experienced industrial engineer that is needed to solve the larger problems. Other gas companies should employ an outside expert engineer or engineering company to do this work for them. It is a job for the specialist.

Mr. John Zander (Chicago): This paper is certainly a credit to Mr. Willson, although he only points in a general way to some of the details encountered by the industrial departments of gas companies, yet every paragraph contains some interesting and valuable points.

It is true that the opportunities of using gas for industrial purposes are enormous, but many new problems and new applications of gas are not yet solved.

Mr. Willson may be quite right in saying "that it takes a gas man a long time to get out of bed after he is awake," but this is equally true of the manufacturers of gas appliances.

A gas company is frequently put into an embarrassing position between the customer and the appliance manufacturer, and stands helpless when appliances are required which are not on the market. And for this reason they are often forced to the so-called home-made apparatus, made under their direction either by their own men or some local shop. The demand is far greater in variety than the supply offered by manufacturers. Especially in large manufacturing centers the sales of this required special apparatus often amount to more than the standard available types sold.

The appliances offered by manufacturers have been greatly improved within the last few years, but this improvement has been rather in more substantial construction and fuel economy than in principles and new applications. The latter are much talked about, but are not brought out.

We have heard for years that heat in radiant form is the most desirable and the most economical for nearly all industrial purposes. This is an old established fact, and yet the gas companies are still anxiously waiting for the appliances in which this principle is worked out.

For an illustration, I will refer to candy furnaces mentioned in Mr. Willson's paper. These furnaces were originally of the atmospheric type, which often burned the edges of the batches of candy and spoiled much of the product, especially hard candy, on account of the large bed of fire required. The blast candy furnace brought out later is a decided improvement on account of a more concentrated fire. These blast furnaces have a lining of fire tile, but principally as a protection to the furnace. The effect of radiation from these tiles is only slight, because they are too far away from the surface of the copper kettle.

How much longer will the gas companies have to wait until they see a candy furnace on the market, which has a heat reflecting surface drawn close to the working surface?

The gas companies in their industrial departments have in recent years been brought face to face with many new problems and they have brought into existence a great number of new types of appliances, heating machines, and special burner equipments for which they should receive due credit.

Unassisted by the manufacturers of gas appliances, they have been coping with these new problems and brought out many new wrinkles in the application of gas as fuel.

It is one thing to make gas, but it is another thing to properly burn it. The burning of the gas brings the money, and therefore this part of the gas business ought to receive close attention.

The success of the electric companies competing with gas is not due so much to improvements in power generating stations, as to the new appliances, new lamps, etc., put into the hands of their salesmen.

One of the hardships of an industrial gas salesman is that he is confronted with a thousand different problems in factory methods with only a dozen or two appliances in his catalogue. His job is very much different and harder than that of salesmen in other lines in that he often has to recommend and sell goods unknown to the trade and to himself. There can be no

successful industrial sales organization, unless it is backed up by their industrial engineers.

The gas companies are wide awake to the possibilities in the industrial field. They are by no means rolling easy in sleep, but they have long realized these difficulties connected with this new business. For this reason, they have acted slowly and conservatively, especially the smaller companies.

Only the larger companies, operating in greater industrial fields have been able to develop an adequate industrial organization of their own to go after this new business successfully. A gas man is always sure and well prepared before he proceeds.

The progress and success of the industrial departments of gas companies depends upon the development of better gas burning appliances, and upon the careful application of burner equipment to the many thousand different processes of manufacture where heat is required.

Rest assured that the gas companies are wide awake to these conditions, and every one of their representatives here to-day is eager to hear of some new and decided progress which has been made in this new and most interesting field, and especially of some new appliances brought out by the manufacturers.

The industrial appliance problem is like a two-section extension ladder with 100 spokes, 50 in each section. On the uppermost spoke stands surface combustion, claiming recognition of 100 per cent. efficiency, but it stands there with one foot on the spoke and the other foot up in the air.

Mr. Willson credits other standard appliances with 56.9 per cent. efficiency. We will take his figure as being correct and say, we are up to between the 56th and 57th spoke. Surface combustion claims 40 more per cent. increased efficiency under favorable conditions. From the 56th spoke we can climb a considerable distance higher by the aid of radiant heat in a more efficient way. It is the privilege of all industrial appliance manufacturers and designers to go at least 30 spokes higher without infringing on surface combustion. This will give the

gas companies appliances of 50 per cent. greater efficiency to use in their battle to secure the industrial gas consumption.

THE CHAIRMAN: Mr. Riley, we would like to hear from you.

MR. H. M. RILEY (Baltimore): I am connected with the distribution part in Baltimore, and only come in connection with the Appliance Department, later. I have charge of the appliance testing laboratory, and we only test these appliances for efficiency. I am not connected with the sales end, and I am not in position to tell anything that has been done in our case along the line of blazing a trail for the sale of gas appliances.

MR. J. H. WALKER (Milwaukee): Mr. Chairman, I take a great deal of interest in the industrial fuel business. I heard a paper read this morning in which the manufacturer of gas appliances was severely criticised, for the reason that he has not supplied the proper apparatus that the gas company needs, quick enough. The gas companies expect the manufacturer of gas apparatus, who starts out ignorant of what the public requires, to acquire that information ahead of the gas company. It rarely happens, that this object is accomplished. He must learn by experience, by contact with the consumer, what the consumer needs, as well as what the engineer of the gas company requires. In my opinion the manufacturer of gas appliances has not had the support that is due him from the gas companies of the country. He has brought out certain lines of apparatus and is depending on the sale of such apparatus for the returns on his investment. In many cases the gas companies have ordered one of these pieces of apparatus with a firm intention of taking it home and making something like it, instead of giving the manufacturer an order for another one, and leaving that business to the manufacturer of gas appliances. This certainly has been very discouraging to the manufacturer and while the gas companies expect large efficiency in the manufacturer's design, it seems to me they do not give him the moral or financial support that is his just due.

I am not making these remarks for the purpose of giving the impression that I feel individually injured, but I started in this business very early, much earlier than many of the men in this room, and I know that my desk was many times filled with inquiries for information, but no orders, which was rather discouraging to the general expansion of the gas appliance manufacturer's business.

The future of the business is certainly great. The gas companies are now depending a great deal on their industrial sales for increasing their income, and it is a part of the business which should be encouraged in every way. I do not know that we have anything especially new in Milwaukee to explain to you at this meeting, but we are still doing an industrial business and keeping busy at it right along, but it is all along regular lines of expansion of commercial business.

Mr. Henry O. Loebell (New York): While I am not a member of the Institute, I would like to have the privilege of the floor.

I am interested in the gas and electric business and have very carefully read the papers and listened with a great deal of interest to the discussion that has taken place.

In two of the papers there is a similarity, and particularly in one statement, namely, the allusion made to competition with electricity interpreted by the calorific value of one kilowatt hour as compared with the calorific value of a cubic foot of gas.

In all cases it appears that the gas man takes the viewpoint that, due to the fact that he is able to sell more B. t. u. per dollar, that he is entitled to the business.

It is very inconsistent to take that viewpoint and in order to satisfy himself that it is incorrect, all he has to do is to ask how he is getting business from oil and coal with a much higher cost per unit B. t. u.

I am satisfied that this viewpoint which the gas man takes has been very detrimental to his welfare, as it postpones his analysis of the actual cost of production where fuel is used, and he never comprehends the real issue in competition.

I believe that I can afford to be a prophet and that I can prophesy that in the near future some gas man will write an article on the melting of brass and show how impossible it is for the electric company to take on this business and prove his argument by stating the fact that a kilowatt hour of heating energy costs a great deal more than the same amount of heating energy when produced from gas. The appliance and its efficiency is the determining factor of cost and it matters very little to the customer whether he buys B. t. u. in the form of gas or electricity, as long as the effectiveness of the B. t. u. he purchases is great enough to give low cost of production.

The gas man is considerably more justified at the present time with the information that is available and the scientific research work that has been done by the electric company, in certain fields, such as enamelling and baking, in claiming that that field belongs to him. But it is unfortunate that the electric people were the ones that forced them to wake up and secure that very desirable information and research and greatly capitalize that knowledge.

In general I would say that the gas appliances at the present time, considering the length of time it took to develop them, are the most inefficient pieces of apparatus that any industry has to use, and that if the "man from Mars" came down to earth and saw a display of gas burning appliances, he would be greatly in doubt whether engineering knowledge had been developed along the line of heat transfer, insulation, recuperation, and regeneration as well as the correct use of proper materials in gas heating furnaces.

I am satisfied that if the correct methods of engineering are used in building appliances, the gas business will displace every bit of fuel used in industrial heating, and that the advantages that will accrue to the manufacturer from this change will more than justify him in spending the necessary money in buying the most efficient and up-to-date appliances.

Mr. R. B. Brown: I am sorry I was not here earlier. I do not know the name of the preceding speaker; but I think the

statements that have been made by him are so absolutely false, so absolutely short of the truth and so dismal an interpretation of what is being done by the gas men to-day that it should not go on our record. There was not anything that he said that I cannot absolutely refute by facts and citations of experience.

The imputation he makes that the gas man is not attacking his problems from an engineering standpoint and from the standpoint of his consumer is absolutely false. That I know. And it makes me so mad I can not talk right. (Laughter.)

Now, I will tell you that in several companies—several of the most progressive companies in this country, and there must be plenty of others (the limitation of my time and my experience makes it impossible for me to talk from personal knowledge beyond the experience of a few companies), but I know with those companies where I am acquainted with their procedure and their engineering and industrial practice, that they are not talking about B. t. u. in the watt or in the foot of gas, they are discussing those problems with their consumers on the results obtained only. That is the only thing the consumer cares anything about.

I had the pleasure of talking before the Institute 10 years ago, when I said that the consumer is not concerned in the cost of gas, the quality of the gas or anything else. He is concerned only with what you enable him to do with that gas, the results that he obtains in his business. Now, in our Industrial Department we found a long time ago that the salesman of the ordinary type has no place, that we have to have trained engineers of such a breadth of training and of experience and of the type of mind that are able to go out and study the consumer's problems so that they shall know better than he does what his problems in heating are, and how they should be attacked.

There has been something said here about the failure of the gas man to realize the benefits from recuperation. I can show you, and I know there are plenty of others that have attacked that thing from that standpoint, that recupera-

tion has been tried; it has been successfully tried in some cases; in other cases it has been found that it did not pay. And it is dollars and cents with the consumer as the only argument that we have.

As to insulation, he speaks as if the gas man did not know what insulation was. If there is anything new in insulation that we do not know, I want to be shown. We have kept very close to the latest work in insulation. We are making use of everything that is found. It all hinges on that one statement that was made that we are not interested in the consumer's problems, that we are talking abstract prices as affected by the cost of gas and the cost of current. We are not doing anything of the kind.

There were several other statements made, that the management of the companies do not show any interest in this development. I want to tell you that the management of those companies that I know best about are taking more interest in the details of their industrial work than they are in any other one thing, not forgetting other problems that they have; not forgetting the lighting business for instance which we have a great deal of and are going to keep. But the industrial situation is perhaps the most important thing we have to-day. And I do not believe that any manager who is worthy of the name is not taking an interest in it.

We are having more and more of an influx of engineering talent into the management of our companies. It is one of those things that evolution has brought about. And I do not believe that any one of those men, any one of those engineers who now have more or less to do with the executive details of the management of our companies, would allow a statement like that, made by the gentleman that spoke here a moment ago, to go unchallenged. I am sorry that the statement was made.

Mr. Treadway: Mr. Chairman, in Detroit we have probably had as much competition with electricity as any concern in any city in the country. And I think that we are able to judge just about what the merits of the respective fuels are.

Mr. Loebell brings out the point that the gas man argues B. t. u. in kilowatts against B. t. u. in gas. Now, I would like to call the attention of the Institute to the arguments of our competitors. They are not B. t. u. and kilowatts against B. t. u. and gas, but they are greater safety, such as was brought out in the paper yesterday—or the discussion yesterday, showing that the little child could not turn a switch very well, but might turn the cock of a gas range and be asphyxiated.

Arguments like that, and arguments of superior gloss obtained in the electric oven, are questions which are very hard to demonstrate the truth of either way. We might take a hundred years, and one man might produce a lot of statistics to show that gas was safer than electricity; and the other man might produce a lot of statements and statistics to show that electricity was safer than gas; and when you are all through it would be a matter of opinion, and a matter of the side which produced the evidence, but it would not be the truth.

If you get right down to facts and demonstrate an electrical appliance against a gas appliance, both of them being the best that we can obtain, the electric man must absolutely back out. His arguments are all generalities and things that you cannot prove, such as "The meat tastes better cooked in the electric range than it does in the gas range." If they are both cooked under the same conditions no one could tell the difference.

We have the same arguments when we replace charcoal broiling. Every chef says, "The taste! My gracious, you are going to spoil all the fine steaks! The taste is gassy when it is done with gas!" But nevertheless it is all done with gas at the present time—not all, but I should say that we are getting a large share of the broiling business with gas.

When you come down to arguments such as the gloss you could not tell the difference if you used a microscope, and you could not tell the difference unless somebody told you which was which, then you might imagine it if you had a sufficient income from the electric industry. I want to say that those arguments are the danger which we must look out for, and we must not allow ourselves to be influenced by mental sug-

gestion. It is up to us to get down to facts and see the real state of affairs.

In closing I want to bring out a point about the electrical industry going to the bottom of things, $50,000 a year men, scientific men going into this problem for 3 years before they came out with the results. And I want to say that when they came out with their results it was found afterwards that most of them were wrong.

I might illustrate that by their procedure in japanning: The first installations they made were made on the fireless cooker principle, and they necessarily had to be in order to get anywhere near the cost of doing the work with gas. After a number of fires and explosions, and some injury to the men, they decided that the ovens had to be properly ventilated. This was known to the gas men and had been known to the gas men and the japanning men for years. It is now known to the electrical men. In their installations they put in plenty of ventilation. In fact I know of one installation where they went to the other extreme and put in so much that there was a veritable whirlwind going through the oven. But they had a scientific reason why that was the proper thing.

The Chairman: I am very glad that we heard from Mr. Loebell, if for no other reason that it brought out something from Mr. Brown and the other gentlemen that have spoken.

It is too bad that we judge from insufficient data. A neighbor of mine was knocked over using a vacuum cleaner— received a shock. I do not think that is a reason why people should not use vacuum cleaners. Another lady was killed in the bath tub, I believe by turning on the electric light switch, I do not believe that is a good argument against electric lighting. We must judge everything by the net result. And I think that we all, both electric men and gas men, must work for the ultimate result to the consumer.

I do not want to close this discussion if any one else has anything to say.

Mr. Donald McDonald (Louisville, Ky.): Mr. Chairman, it has been some years since I have attended one of these meetings, and I have listened with the greatest interest and pleasure to this discussion. When I contrast it with a meeting 20 years ago, it shows me that the college men have broken into the gas business. The discussions here to-day show that our men do know what heat units mean, that they do know what insulation means, that they do know what heat conduction means, and that they apply this knowledge. But they are necessarily compelled to apply within the limits of the material with which they are dealing.

I was very sorry I did not hear more about surface combustion which I saw at St. Louis. It appeared to me to be the perfection of what could be accomplished with gas. And I know of no problem of the application of heat from heating a room to melting metal, that could not be worked out better with surface combustion than it can in any other way.

One of the gentlemen spoke of sending for a specialist in the case of ills to the human body. Specialists in medicine have multiplied until you cannot count them, but they have not done away with the general practitioner. You need the general practitioner to tell you what specialist to go to. And in the same way the gas man himself cannot hope to be a specialist in all lines of the utilization of gas, but he must be such a general practitioner as will know what problems can be worked out and what can not.

Speaking generally, I would say that no gas man should try to introduce gas for any use for which coal or coke will do equally well. No gas man should try to introduce gas for any purpose for which electricity will do very much better. Between those two limits there is an enormous field. The gas men have already covered a great deal of it. Compare fuel gas sales to-day with what they were 10 or 15 years ago, and see if they have not. Enormous as the field is I believe I am looking to-day into the faces of men who are intelligent enough and energetic enough to conquer that field.

Mr. John G. Learned (Chicago, Ill.): Mr. Chairman, the company that I have the honor to be associated with is engaged in the sale of both gas and electricity. Therefore, I am of the opinion that I am safe in saying that the industrial gas business is bringing both the electric and gas interests to a point where they are co-operative competitors. We all know that knocking a competitor's product creates an element of doubt in the customer's mind, and the chances are, in the majority of cases, that immediately neither service is sold, consequently there is a loss of income to either one industry or the other. Those gas companies that offer an industrial gas rate can well afford to be on friendly terms with the electric companies. It seems logical they should meet on a common ground. In large industrial manufacturing concerns, there is a demand for both gas and electric service, and in some cases it is impossible to consummate negotiations for either service without the other.

Therefore, if both the gas and electric interests will co-operate, it is very apparent that they will work to their common good. Quite frequently, our electric contract department is endeavoring to get the power business of an industrial concern, and heating problems naturally arise. As a result of being in a position to offer an industrial gas rate we have been successful not only in obtaining electric business, but we also have obtained the gas business, and so *vice versa,* the gas company may be negotiating for the sale of industrial gas and may not be able to make very much progress unless the company with which it is negotiating purchases central station electric service.

I would strongly urge that the management of the gas companies make it one of their prime duties to get on friendly terms with the management of their local electric companies, with a view of both companies co-operating in such a way as to enhance their individual interests.

Mr. John B. Redd (Jersey City, N. J.): I have found it a very good rule to make the best of conditions as they are

and endeavor to improve those conditions to the utmost advantage.

One thing that seems to be lacking in the commercial departments of gas companies is the "Selling Punch." We have advertised 1,000 usages of gas for a good many years and to-day this fuel is used for more than 1,000 different purposes. We have hundreds of gas appliances on the market which can be sold by first-class salesmen and when placed on your gas lines will bring in good revenues. One appliance suggests the use of another, and, when new appliances have been developed by the industrial fuel engineers and manufacturers, they in turn can be sold through the commercial departments. There is one point in regard to selling appliances or to the sales department which is practiced by every successful manufacturer regardless of his business, and that is setting aside a certain sum of money or adding a percentage to the price of his goods as a selling expense. That is a legitimate charge which I believe will eventually be recognized by rate commissions, at which time the selling cost will become a fixed item in the cost per 1,000 cubic feet of gas delivered to the appliance.

Mr. Herman Russell (Rochester): I would like to bring this thought to the members. It seems to me that the discussion this morning has brought out quite clearly the necessity of a very intelligent study on this whole subject. In that connection I think there should be a great deal closer co-operation between the two national gas bodies, and also the manufacturers appliance association. And I think also a great deal more money should be used in the investigation of this subject than is being spent to-day.

The larger companies are spending a great deal. As manager of such a company we have a well organized industrial sales department. We do maintain an efficient corps to handle this business, just as Mr. Brown's company in Milwaukee does. There are a great many companies that cannot afford to do this. And we in Rochester are duplicating without ques-

tion a great deal of the experiments on which Mr. Brown in Milwaukee is also working. The same is true of other cities. There should be a clearing house for this information. There should be a place where this work can be done. We have neglected to bring to the manufacturers of appliances clearly the needs which the industry calls for. Unless it is brought to the manufacturer's attention, the manufacturer is not in touch with these needs. We wait until the last minute, and then we rush to the manufacturer of appliances and want him to do certain work—special work in most cases. We cannot expect him to produce that apparatus on a moment's notice. Very often we do not know exactly what we want ourselves.

As far as the decision between gas and electric appliances goes it is important first to try to give the consumer either gas and electricity as we may think will be to his best interests to use. The trouble is we do not always know ourselves. We do not know whether gas or electricity will do the work most satisfactorily for him. We have not the knowledge. We have not tried it. It is a new field, and we can only tell by experimental work.

My point is that a lot of effort is being wasted to-day that should be concentrated. Committees should be appointed—at least there should be a joint committee from these three associations working on it. And it is a great undertaking to ask men to serve on these committees, at a large expense, and have this expense borne by the individual companies who are supplying the men to these committees. It should be borne by the industry at large. It is not fair for Rochester and Milwaukee and some other company to carry on this work and bear this expense year after year. It should be borne by the industry. It is a shame that an association of the size of the American Gas Institute, and an association as large as the National Commercial Gas Association, should allow that condition to exist. The expense should be borne by all of us. We should have the money in our associations to spend on

this work and to give these committees to work with. That is the way to solve these problems.

Mr. W. J. Serrill: I am in accord with Mr. Russell's remarks. At the same time I do not think we should lull ourselves to sleep with the thought that we are not going to have competition in the industrial field. I am reliably informed that the great company that develops electrical appliances at its laboratories in the eastern part of New York State, is spending large sums of money in the development of industrial electrical appliances. And I have no doubt that they are going to fill the complete field. There is no industrial purpose, for which a furnace is needed, where gas can be applied, which is not going to be filled likewise with an electrical furnace which will do the work probably equally well.

Mr. H. W. Peck (Schenectady, N. Y.): I wish to express my appreciation of the various comments which have been made relative to my remarks yesterday. As I frankly stated, that was just the purpose of my remarks, and I appreciate the response.

With regard to Mr. Serrill's remarks, we have a very interesting case in Schenectady, a city in the eastern part of New York State, where much development work is being done regarding electric installations. I realize what a big responsibility it puts upon the Mohawk Gas Company, its officers and engineers. We have realized this before this meeting, and are exerting our very best efforts to install in the electrical works of that city the highest type of industrial gas appliances that we know of, or can learn of. In many, I might say in most cases of our installations, we are in direct competition with electrical installations, designed by them, and re-designed, and again re-designed. In the case of one of our latest installations, where we used surface combustion, which has been working very satisfactorily indeed for about 4 months, they have re-designed and rebuilt a corresponding electric furnace three or four times. Still we are well ahead of them,

and are fully confident that we will continue to be in that installation.

I want to say that they are very fair with us, giving us every opportunity to make gas installations. I use these words advisedly, "give us opportunity to make the installations," as they charge up their experimental work to the development work of electrical installations, and it is up to us oftentimes to bear the brunt of the expense of the gas installation. And their officials have told us frankly they wish to know the exact merits of the gas so that they will not waste their money in developing things for which there will be no market. It is the exact truth that they are seeking. They put the brunt up to us to see that the best gas installation is made, and they take the responsibility with their experts of getting the very best electrical installation.

I think that the next year will see some very interesting work done there, and I hope that we can do our part in passing along to other members of the Institute the good word success.

Mr. Geo. H. Waring: I would like to make a motion along the lines Mr. Russell suggested, that a committee be appointed —or the recommendation be made to the Institute that a committee be appointed along the lines suggested by Mr. Russell.

Mr. Russell Sard (Albany, N. Y.): I should like to second that motion, Mr. Chairman. If I may take one minute, I would state that I know the difficulties of development work, as I have been developing surface combustion for at least 3 years. I agree with a great deal that has been said here, and I disagree with a great deal that has been said. I feel that the main reason for the rapid development of the electric industry is the fact that there are two or three big companies, making a lot of profit, able to put hundreds of thousands of dollars into any individual development and getting the active co-operation and the help of the central stations. There are a great many big companies in the gas business, all doing excellent work. They, however, are local, and the results of their work are largely local. In the electric field the big electric supply companies

cover the whole field. They put unlimited money into the development and they get the results. The gas range manufacturers have not the profit to put into development. They can do a certain amount. I believe that the range manufacturers have spent more of their profits in developments, proportionately, than the big electric companies. Nevertheless, the volume is not there and they have not been able to afford to do as much as they would like to do.

I am not interested except in the hotel end of the business in industrial appliances, but I have heard a request and desire on the part of gas men for industrial appliances. Now, it does not do any good to merely talk about that. We have got to formulate a plan to get something of that sort if the gas business is going to develop the industrial field, and I therefore second this motion.

The Chairman: Gentlemen, it has been regularly moved and seconded that a recommendation from this Section be made to the Institute at to-morrow's general meeting urging the appointment of a committee on this whole subject of gas for industrial purposes. What is your pleasure?

(The motion was duly carried.)

We will now close the discussion. If there are any here who would like to add written discussion they may do so, and send it to the Secretary.

We will now have the report of the Committee on Consumer's Meters.

Mr. W. K. Harrington (New York): Inasmuch as the paper is long, and the time short, and as the paper has been printed and circulated, I would suggest the reading of the paper be waived and the discussion follow.

REPORT OF COMMITTEE ON CONSUMERS' METERS.

We beg leave to submit the following as the report of the Committee on Consumers' Meters.

The first subject taken up by the Committee was that of meter connections, this being left unfinished by the Committee on Meter Connections last year. It has been tacitly supposed that the Institute adopted the standard which the American Gas Light Association adopted in 1888 and 1889, but as a matter of fact the Institute has not as yet put itself on record as having adopted any standard for meter connections.

While it is true that the Institute has not adopted any standard for unions for gas meters the meter screws, caps and swivels, constituting these unions, have in recent years been made to conform closely to the dimensions in the standard adopted by the American Gas Light Association, so that in the preparation of a standard for adoption by the Institute at this time it was feasible for the Committee to accept the dimensions of the unions in general use, with but few exceptions. The exceptions were made to obtain better clearances between swivels and screws, between swivels and caps and extra strength where it was thought necessary in order that the same patterns could be used for casting the parts in either brass or iron; the tendency being toward the use of galvanized malleable iron meter unions.

The attention of the Committee has been called to the advisability of using round instead of octagonal meter union caps, as is customary at present. It is claimed that the consumers cannot manipulate the round as easily as they can the octagonal cap, that the round cap is plainer and consequently should cost less, and that the round cap may be made up with the usual pipe wrench as readily as may the octagonal cap.

Drawings and tables of dimensions of the proposed standard meter unions are shown on pages 859, 860, 861 and 862.

This Committee respectfully recommends that the Ameri-

can Gas Institute place itself on record as having adopted the meter unions, in either malleable iron or brass, as herein proposed.

The principal work of the Committee has consisted in obtaining information for statistical data with the object of answering certain questions which have been propounded to the Committee for their consideration. A copy of these questions was published in the February issue of the Gas Institute *News* with a request that such gas companies as were interested in the subject send answers to the Chairman of the Committee. It is to be regretted that up to date these questions have brought forth no response. Further, copies of these questions were sent to 17 of the leading gas companies operating 4,661,697 meters. Sixteen of these companies, operating about 99 per cent. of the meters involved, answered these questions more or less fully. The companies to whom these questions were sent were located in the east and middle west so that their operating conditions, as far as climate conditions are concerned, would be practically the same. The range of the proof of meters designated as "correct" was taken 2 per cent. either way of 100 as we believe this is the most general practice.

The questions will be taken up and considered in detail in the order of what would seem to be their relative importance rather than in the order in which they were sent out.

Acting along these lines the first question to be considered is:

How Often Should a Meter be Brought in for Test?

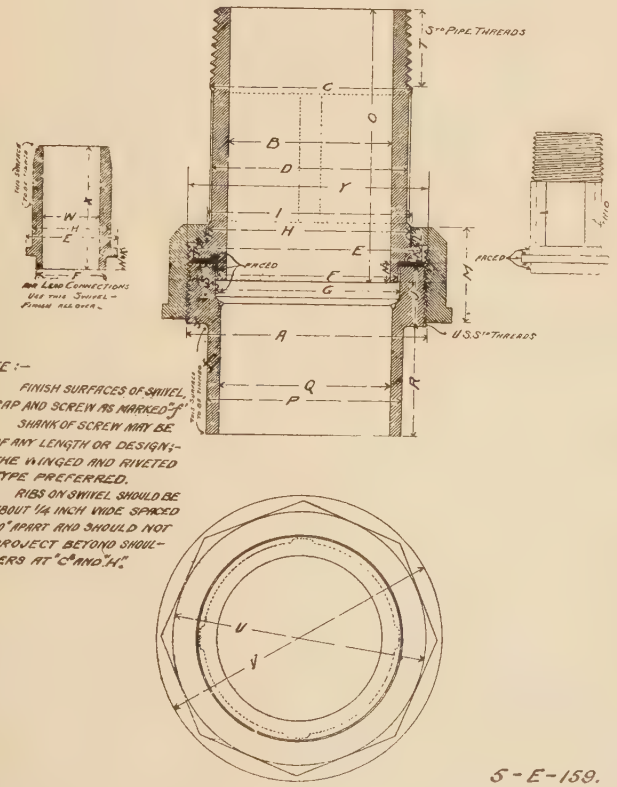
Length of Age Period in Years	Number of Companies Answering	Number of Meters Represented	Percentage of Meters Represented
4	4	202,723	5%
5	5	2,463,578	55%
6	1	68,263	1%
7	3	1,604,307	36%
8	1	118,258	3%
	Total	4,457,129	100%

The more that this subject of bringing in meters for what is known as "Change for Age" is investigated the more apparent it becomes that no general rule can be made which will apply to all companies or even to all the meters of the same company. It is apparent from the information and statistics obtained that the length of time that a meter may be safely left in operation depends upon not only the kind of gas used but upon the location of the meter, the size of the meter and to a great extent (which so far it has been unable to determine) to the number of times a meter has been reset without having received repairs or thorough examination. Most of the answers received are more or less the expression of personal opinion, more or less derived from the result of experience without having studied the matter from an analytical point of view.

It is proposed to submit some tables, which, while they may not decide the question as to the length of time a meter should be allowed to be in use, they may lead to action being taken along lines in the future which may be of some assistance in solving the problem.

The first table submitted will be the results of "Age Tests" on 391,469 meters, these tests being arranged according to the nature of the gas manufactured. It would seem as if these tests show conclusively that certain kinds of gas do not have as deleterious effect on meters as others, the meters being used with natural gas standing up the best while those used with a mixture of enriched water gas and coal gas showing the poorest results.

PROPOSED STANDARD METER UNION
EITHER BRASS OR MALLEABLE IRON.



NOTE :—

FINISH SURFACES OF SWIVEL CAP AND SCREW AS MARKED "f"

SHANK OF SCREW MAY BE OF ANY LENGTH OR DESIGN;— THE WINGED AND RIVETED TYPE PREFERRED.

RIBS ON SWIVEL SHOULD BE ABOUT 1/4 INCH WIDE SPACED 90° APART AND SHOULD NOT PROJECT BEYOND SHOULDERS AT "C" AND "H".

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OCT.-1916.

PROPOSED STANDARD METER UNION.—DIMENSIONS OF SCREW-CAP-SWIVEL.

SIZE	3 LIGHT	5 LIGHT	10 LIGHT	20 LIGHT	30 LIGHT	45 LIGHT	60 LIGHT	80 LIGHT	100 LIGHT	150 LIGHT	200 LIGHT	250 LIGHT	300 LIGHT	500 LIGHT
A	63/64	1 1/8	1 7/16	1 53/64	2 3/64	2 17/64	2 7/16		3	3 1/2	3 1/2		4" FLANGE CONNECTIONS	5" FLANGE CONNECTIONS
B	7/16	19/32	13/16	1 1/32	1 11/32	1 13/32	1 3/16		1 31/32	2 13/32	2 13/32			
C	11/16	27/32	1 1/16	1 5/16	1 21/32	1 29/32	1 29/32		2 3/8	2 7/8	2 7/8			
D	41/64	13/16	1 1/16	1 3/32	1 5/8	1 27/32	1 27/32		2 5/16	2 13/16	2 13/16			
E	7/8	1	1 5/16	1 5/8	1 23/32	2 1/8	2 1/4		2 13/16	3 5/16	3 5/16			
F	21/32	3/4	1	1 5/16	1 1/2	1 45/64	1 23/32		2 7/32	2 5/8	2 5/8			
G	11/16	13/16	1 1/16	1 3/8	1 35/64	1 3/4	1 31/32		2 5/32	2 1/16	2 1/16			
H	23/32	7/8	1 3/32	1 11/32	1 11/16	1 15/16	1 15/16		2 7/16	2 15/16	2 15/16			
I	3/4	29/32	1 1/8	1 13/32	1 23/32	1 31/32	1 31/32		2 1/2	3	3			
J	3/8	13/32	7/16	1/2	9/16	5/8	5/8		3/4	1	1			
K	1/8	1/8	1/8	5/32	5/32	5/32	5/32		3/16	9/32	9/32			
L	3/32	1/8	1/8	5/32	3/16	3/16	3/16		1/4	1/4	1/4			
M	19/32	41/64	11/16	13/16	51/64	31/32	31/32		1 3/16	1 17/32	1 17/32			
N	5/32	5/32	5/32	3/16	1/4	1/4	1/4		1/4	5/16	5/16			
O	2 1/8	2 3/16	2 5/16	2 3/4	2 7/8	3	3		3 13/16	4	4			
P	3/4	13/16	1 1/16	1 7/16	1 5/8	1 13/16	2		2 3/8	2 13/16	2 13/16			
Q	9/16	5/8	5/8	1 1/4	1 13/32	1 3/16	1 3/4		2 1/16	2 1/2	2 1/2			
R	9/16	5/8	3/4	1	1 1/4	1 3/8	1 3/8		1 5/8	1 5/8	1 5/8			
S	3/16	7/32	9/32	1/4	5/16	5/16	5/16		5/16	7/16	7/16			
T	3/16	9/16	11/16	3/4	7/8	1	1		1	1 1/4	1 1/4			
U	1 3/64	1 19/64	1 5/8	2	2 9/32	2 25/32	2 21/32		3 5/16	3 13/16	3 13/16			
V	1 11/32	1 1/2	1 23/32	2 3/32	2 1/2	2 13/16	3		3 1/4	4 1/4	4 1/4			
W	7/16	19/32	13/16											
X	1 5/8	1 11/16	2 5/16											
THREADS PER INCH ON SCREW	18	12	11 1/2	11 1/2	11 1/2	11 1/2	11 1/2		11 1/2	11 1/2	11 1/2			
STD PIPE SWIVEL THREADS FOR	3/8	1/2	3/4	1	1 1/4	1 1/2	1 1/2		2	2 1/2	2 1/2			
Y	1	1 5/32	1 13/32	1 55/64	2 5/64	2 19/64	2 15/32		3 1/32	3 17/32	3 17/32			

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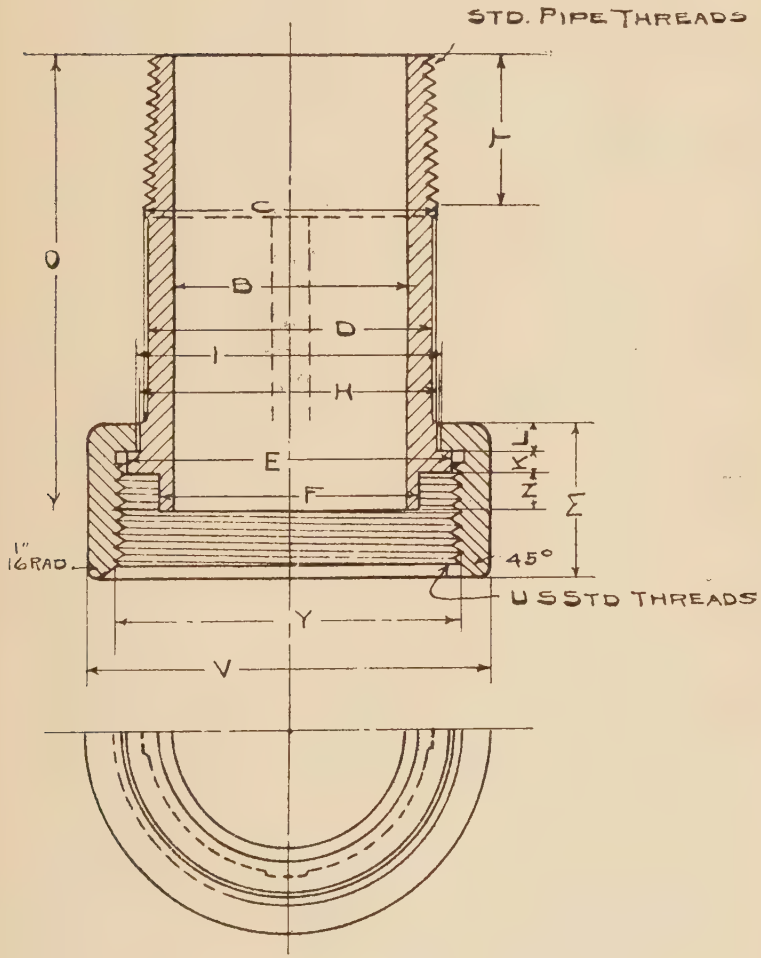
PROPOSED ROUND CAP MALLEABLE IRON METER UNIONS.



NOTES:—

4 Ribs on swivel spaced as shown, about ¼″ wide and should not project beyond shoulder at "C". These ribs may be left out and wall of swivel made cylindrical as per diameter "C".

With exception of length of shank, meter screws to be same as shown on Dwg. 5E 159.

PROPOSED ROUND CAP MALLEABLE IRON METER UNION
DIMENSIONS OF CAP AND SWIVEL.

SIZE	3 Light	5 Light	10 Light	20 Light	30 Light	45 Light	60 Light	80 Light	100 Light	150 Light	200 Light	250 Light
B	7/16	19/32	13/16	1 1/32	1 11/32	1 17/32	1 9/16		1 31/32	2 13/32	2 13/32	
C	11/16	27/32	1 1/16	1 5/16	1 21/32	1 29/32	1 29/32		2 3/8	2 7/8	2 7/8	
D	41/64	13/16	1 1/16	1 9/32	1 5/8	1 27/32	1 27/32		2 5/16	2 13/16	2 13/16	
E	7/8	1	1 5/16	1 5/8	1 29/32	2 1/8	2 1/4		2 13/16	3 5/16	3 5/16	
F	21/32	3/4	1	1 5/16	1 1/2	1 45/64	1 29/32		2 7/32	2 5/8	2 5/8	
H	23/32	7/8	1 3/32	1 11/32	1 11/16	1 15/16	1 15/16		2 7/16	2 15/16	2 15/16	
I	3/4	29/32	1 1/8	1 13/32	1 23/32	1 31/32	1 31/32		2 1/2	3	3	
K	1/8	1/8	1/8	5/32	5/32	5/32	5/32		3/16	9/32	9/32	
L	3/32	1/8	1/8	5/32	3/16	3/16	3/16		1/4	1/4	1/4	
M	21/32	11/16	3/4	7/8	31/32	1 1/32	1 1/32		1 1/4	1 19/32	1 19/32	
N	5/32	5/32	5/32	3/16	1/4	1/4	1/4		1/4	5/16	5/16	
O	2 1/8	2 3/16	2 5/16	2 3/4	2 7/8	3	3		3 13/16	4	4	
T	9/16	9/16	11/16	3/4	7/8	1	1		1	1 1/4	1 1/4	
V	1 1/4	1 7/16	1 3/4	2 1/8	2 3/8	2 5/8	2 7/8		3 1/2	4	4	
Y	1	1 5/32	1 15/32	1 55/64	2 5/64	2 19/64	2 15/32		3 1/32	3 17/32	3 17/32	
Th'ds per in. for Cap and Screw	18	12	11 1/2	11 1/2	11 1/2	11 1/2	11 1/2		11 1/2	11 1/2	11 1/2	
Swivel Std. Pipe Threads for	3/8	1/2	3/4	1	1 1/4	1 1/2	1 1/2		2	2 1/2	2 1/2	

TABLE A

Years in Service	Natural Gas				
	Total	Correct	%	D. R.	%
1 year	10,298	10,211	99	2	—
2 years	3,858	3,791	98	1	—
3 "	2,649	2,603	98	—	—
4 "	2,171	2,121	97	2	—
5 "	1,828	1,778	97	1	—
6 "	1,290	1,253	97	—	—
7 "	770	745	96	2	—
7+ "	859	840	97	2	—
Total	23,710	23,342	97	10	—

TABLE B

Years in Service	Coal and Coke Oven Gas				
	Total	Correct	%	D. R.	%
1 year	—	—	—	—	—
2 years	—	—	—	—	—
3 "	—	—	—	—	—
4 "	54,347	32,118	59	376	1
5 "	19,887	11,673	58	161	1
6 "	18,681	11,372	61	96	1
7 "	—	—	—	—	—
7+ "	—	—	—	—	—
Total	92,915	55,163	59	633	1

TABLE C

Years in Service	Enriched Water Gas				
	Total	Correct	%	D. R.	%
1 year	13,678	9,081	66	167	1
2 years	9,251	5,566	61	103	1
3 "	7,507	4,199	60	110	1
4 "	7,044	3,296	47	124	2
5 "	5,691	2,661	47	119	2
6 "	5,255	2,266	43	123	2
7 "	28,453	13,685	48	311	1
7+ "	150	71	47	3	2
Total	77,029	40,925	53	1,060	1

TABLE D

Years in Service	Mixture of Enriched Coal and Water Gas				
	Total	Correct	%	D. R.	%
1 year	31,258	21,583	69	1,312	4
2 years	22,061	13,052	59	1,084	5
3 "	20,467	10,637	52	1,173	6
4 "	17,557	8,376	48	1,215	7
5 "	13,478	2,930	46	1,093	8
6 "	10,829	5,046	47	848	8
7 "	81,347	43,639	54	1,716	2
7+ "	818	478	58	16	2
Total	197,815	108,947	55	8,457	4

TABLE ANALIZING IN DETAIL THE TESTS GIVEN IN TABLE A ON PAGE 863

Years in Service	Number of Meters Tested	Number more than 2% Slow	Number between 2% Slow & 2% Fast	Number more than 2% Fast	No. D. R.	Per Cent. of Meters				Average Percentage	
						Testing more than 2% Slow	Testing between 2% Slow & 2% Fast	Testing more than 2% Fast	D. R.	Slow of Meters more than 2% Slow	Fast of Meters more than 2% Fast
1	10,298	50	10,111	137	—	.4	98.1	1.3	—	4.54	3.71
2	3,835	13	3,721	101	—	.3	97.0	2.6	—	4.92	3.48
3	2,649	12	2,542	95	—	.4	95.9	3.5	—	3.41	3.76
4	2,171	15	2,072	84	—	.7	95.4	3.8	—	5.93	3.83
5	1,828	21	1,751	56	—	1.1	95.7	3.0	—	5.04	4.08
6	1,290	8	1,240	42	—	.6	96.1	3.2	—	4.25	4.04
7	770	11	741	18	—	1.4	96.2	2.3	—	6.09	4.61
More than 7 yrs.	869	12	831	26	—	1.3	95.6	3.0	—	5.50	4.26
Total	23,710	142	23,009	559	—	.6	97.0	2.3	—	4.88	3.81

TABLE ANALIZING IN DETAIL THE TESTS GIVEN IN TABLE B ON PAGE 863

Years in Service	Number of Meters Tested	Number more than 2% Slow	Number between 2% Slow & 2% Fast	Number more than 2% Fast	No. D. R.	Per Cent. of Meters				Average Percentage	
						Testing more than 2% Slow	Testing between 2% Slow & 2% Fast	Testing more than 2% Fast	D. R.	Slow of Meters more than 2% Slow	Fast of Meters more than 2% Fast
4	54,392	9,805	32,118	12,093	376	18.0	59.0	22.2	.6	3.72	3.58
5	19,887	3,410	11,673	4,643	161	17.1	58.6	23.3	.8	3.70	3.68
6	18,681	3,595	11,372	3,618	96	19.2	60.8	19.3	.5	3.70	3.54
Total	92,960	16,810	55,163	20,354	633	18.0	59.3	21.8	.6	3.70	3.60

TABLE ANALIZING IN DETAIL THE TESTS GIVEN IN TABLE C ON PAGE 863

Years in Service	No. of Meters Tested	No. more than 2% Slow	No. between 2% Fast and 2% Slow	No. more than 2% Fast	No. D. R.	No. D. P. G.	No. no Test	Per Cent. of Meters						Average Percentage		
								Testing more than 2% Slow	Testing betw'n 2% Fast and 2% Slow	Testing more than 2% Fast	No. D. R.	D P.G.	No. no Test	Slow of Meters more than 2% Slow	Fast of Meters more tnan 2% Fast	Fast or Slow of all Meters Tested
1 yr. or less	13,678	3,372	9,081	545	167	433	80	24.6	66.4	3.9	1.2	3.3	.6	3.99	3.00	S 1.47
1–2 yrs.	9,251	2,598	5,666	516	103	304	64	28.1	61.2	5.6	1.1	3.3	.7	4.20	3.04	S 1.56
2–3 yrs.	7,507	2,339	4,199	569	110	246	44	31.2	55.9	7.6	1.5	3.3	.5	4.58	3.12	S 1.64
3–4 yrs.	7,044	2,769	3,296	550	124	273	32	39.3	46.9	7.8	1.8	3.8	.4	4.81	2.99	S 2.10
4–5 yrs.	5,691	1,851	2,661	776	119	240	44	32.5	46.8	13.6	2.1	4.2	.8	4.85	3.16	S 1.51
5–6 yrs.	5,255	1,552	2,266	1,010	123	281	23	29.5	43.2	19.2	2.4	5.3	.4	5.08	3.42	S 1.12
6–7 yrs.	28,453	5,634	13,685	8,492	311	310	21	19.8	48.1	29.8	1.1	1.1	.1	5.03	3.30	S .15
Over 7 yrs.	150	33	71	32	3	11	—	22.0	47.3	21.4	2.0	7.3	—	5.06	3.73	S .49
Total	77,029	20,148	40,925	12,490	1,060	2,098	308	26.1	53.2	16.2	1.4	2.7	.4	4.65	3.26	S 1.03

TABLE ANALYZING IN DETAIL THE TESTS GIVEN IN TABLE D ON PAGE 863

Years in Service	No. of Meters Tested	No. more than 2% Slow	No. between 2% Slow and 2% Fast	No. more than 2% Fast	No. D. R.	No. D. P. G.	No. no Test	Per Cent. of Meters						Average Percentage		
								Testing more than 2% Slow	Testing betw'n 2% Slow and 2% Fast	Testing more than 2% Fast	D. R.	D.P.G.	No Test	Slow of Meters more than 2% Slow	Fast of Meters more than 2% Fast	Slow or Fast of all Meters
1 yr. or less	31,258	5,659	21,583	1,021	1,312	1,512	171	18.1	69.0	3.3	4.2	4.8	.6	4.56	4.15	1.22
2 yrs. or less	22,061	5,466	13,052	1,006	1,084	1,332	121	24.8	59.2	4.6	4.9	6.0	.5	5.52	4.15	1.60
3 yrs. or less	20,467	5,722	10,637	1,208	1,173	1,597	130	28.0	52.0	5.9	5.7	7.8	.6	6.18	4.17	1.90
4 yrs. or less	17,557	5,072	8,376	1,253	1,215	1,532	109	28.9	47.7	7.2	6.9	8.7	.6	6.60	4.25	2.03
5 yrs. or less	13,478	3,702	6,136	1,243	1,093	1,225	79	27.5	45.5	9.2	8.1	9.1	.6	6.85	4.38	1.87
6 yrs. or less	10,829	2,444	5,046	1,501	848	923	67	22.6	46.6	13.9	7.8	8.5	.6	6.81	4.35	1.08
7 yrs. or less	81,347	20,751	43,639	13,928	1,716	1,232	81	25.5	53.7	17.1	2.1	1.5	.1	6.41	4.25	.86
Over 7 yrs.	818	175	478	131	16	17	1	21.4	58.4	16.0	2.0	2.1	.1	5.69	4.02	.54
Total	197,815	48,991	108,947	21,291	8,457	9,370	759	24.8	55.1	10.7	4.3	4.7	.4	6.14	4.26	1.27

TABLE SHOWING COMPARATIVE TESTS BY SIZES IN CONNECTION WITH THE NUMBER OF YEARS IN SERVICE

Size	1 year or less			1-2 years			2-3 years			3-4 years			4-5 years			5-6 years			6-7 years		
	Total	Correct (98-102)		Total	Correct		Total	Correct		Total	Correct		Total	Correct		Total	Correct		Total	Correct	
	No.	No.	%	No.	No.	%	No.	No.	%	No.	No.	%	No.	No.	%	No.	No.	%	No.	No.	%
3	88	65	74	119	70	69	115	70	61	111	49	44	76	37	49	55	24	44	180	67	37
5	430	348	81	410	309	75	255	189	84	192	103	53	111	49	44	58	20	34	311	152	49
10	18	17	94	26	19	73	13	7	54	17	11	65	8	4	50	6	4	67	23	9	39
20	12	9	75	9	9	100	14	7	50	6	4	67	7	3	43				6	5	83
30	3	3	100	2	2	100	1	—	—	1	—	—	1	1	100	1	1	100	5	2	40
45	3	3	100	3	1	33	1	1	100				1		—				2	—	—
60				3	2	67				2	1	50				1	1	100			
100	3	3	100	2	1	50							1	1	100				2	—	—
	557	448	80	574	413	72	399	274	69	329	168	51	205	95	46	121	50	41	529	235	44

The next table submitted would tend to show that the location of the meter is also as important as the nature of the gas which the meter passes. The kind of gas which the meters passed in the next following tables, in connection with the location of the meter, was a mixture of coal gas and water gas, enriched. The period for which these tests were made covered a number of years. Where meters were set in toilets it generally applies to meters setting in tenement houses where the meter itself is subject to dampness and cold drafts. In apartment houses the meters usually set on the inner wall of the apartment where the temperature is normal and not subject to extremes. In hot cellars the meters usually set in the cellars of apartment houses where the temperature is apt to be above the normal in the winter time and about normal in the summer time. In cold cellars meters are set in exposed, drafty and unheated cellars of large tenement houses. Meters setting in basements are usually fairly well located as they are generally placed in the living room of the party occupying the basement. Meters setting in stores are most frequently in the front part of the store under the show window.

LOCATION OF METER

Reasons why brought in	Toilet		Hall		Apartment		Cold Cellars		Hot Cellars		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Non-registering	194	9	113	10	274	3	672	7	382	6	1635	5
Not passing gas	232	11	118	10	408	4	706	7	350	6	1814	6
Lights jumping	758	34	261	23	1015	11	2429	26	2286	37	6749	23
Meter leaks	243	11	130	11	898	9	933	10	635	10	2839	10
Dial glass broken	24	1	8	-	183	2	221	2	181	3	617	2
To please customer	5	—	2	—	50	—	31	—	27	—	115	—
P. P. in place of ordinary	29	1	1	—	620	7	10	—	2	—	662	2
Prepayment trouble	—	—	—	—	1685	17	—	—	—	—	1685	6
Fire	5	—	1	—	37	—	28	—	9	—	80	—
Other size required	2	—	3	—	49	—	115	1	91	1	260	1
High bill	—	—	—	—	—	—	1	—	4	—	5	—
Not in use	180	9	94	8	2787	29	1661	18	380	6	5102	18
Alterations in buildings	6	—	24	2	507	5	510	5	36	—	1083	4
For test	500	23	359	32	895	9	2076	22	1743	28	5573	19
Totals	2198	8	1114	4	9408	33	9393	33	6126	21	28219	

There was an interval of 4 years between the compiling of the two following tables:

Location of Meter	No. Correct	%	D. R.	%	Total
Toilets	2307	49	244	5.4	4666
Halls	502	52	51	5	955
Apartments	21679	63	1388	4	34260
Cold cellars	12378	46	2448	9	26847
Hot cellars	5976	50	802	7	11968
Basements	2113	64	101	3	3287
Stores	730	56	70	5	1295
Totals	45685	55	5104	6	83278

LOCATION OF METER

Location of Meter	Correct	%	D. R.	%	D. P. G. or Stuck	%	Total	%
Toilets	1275	28	575	13	766	17	4509	8
Halls	830	31	273	11	369	15	2520	4
Apartments	10541	60	688	4	1064	6	14479	30
Cold cellars	6654	31	2789	13	2899	14	20954	37
Hot cellars	4018	34	1566	13	1235	10	11699	20
Totals	23318	43	5891	11	6283	11	54161	19

The following set of tables were used in connection with enriched water gas and in this instance the great majority of the meters were in private dwellings, setting in cellars.

Period on District	1 year or less			1-2 years			2-3 years			3-4 years		
Location	Total	Correct		Total	Correct		Total	Correct		Total	Correct	
	No.	No.	%	No.	No.	%	No.	No.	%	No.	No.	%
Cellar	97	91	94	161	141	88	165	139	84	138	70	51
Rooms	9	8	89	6	5	83	11	10	91	6	4	67
Bathroom	7	6	86	—	—	—	2	2	100	1	1	100
Basement	3	3	100	2	2	100	3	3	100	2	1	50
Hall	2	2	100	1	1	100	3	2	67	1	1	100
Store	8	8	100	11	7	64	8	8	100	3	1	33
Totals	126	118	94	181	156	86	192	164	85	151	78	52

Period on District	4-5 years			5-6 years			6-7 years		
Location	Total	Correct		Total	Correct		Total	Correct	
	No.	No.	%	No.	No.	%	No.	No.	%
Cellar	102	44	43	87	35	40	542	207	38
Rooms	8	4	50	5	4	80	44	21	48
Bathroom	5	4	80	1	—	—	6	2	33
Basement	1	1	100	—	—	—	3	2	67
Hall	1	—	—	1	—	—	9	5	56
Store	1	—	—	3	1	33	11	5	45
Totals	118	53	45	97	40	41	615	242	39

It would seem as if the figures given in these tables would indicate beyond any reasonable doubt that the location in which the meter sets has a great deal to do as to whether the meter operates satisfactorily or otherwise.

The next tables given are those tabulating the yearly tests for meters for three consecutive years, the total number of meters tested being 315,004. These tables would tend to show that the larger sizes of meters have a tendency to register more correctly than the smaller sizes. In these tabulations it will be noticed that the 3-light prepayments seem to register more correctly than some of the other sizes. This apparent discrepancy is due to the fact that the prepayments are located inside the apartments which confirms still further that the location of the meter is of a great deal of importance, as the 3-light regular meters would not ordinarily set in an apartment, and there is a wide variation between the accuracy of the 3-light prepayment and the 3-light regular.

Size	Total Number	Correct	Per cent.	D. R.	Per cent.
3 lt. P.P.	23258	15163	65.2	912	4.
3 lt.	34832	15458	44.3	2675	7.6
5 "	14534	8691	59.1	719	4.9
10 "	6110	3588	58.7	491	8.
20 "	1820	1144	62.8	48	2.6
30 "	604	427	71.5	9	1.5
45 "	389	292	75.0	4	1.0
60 "	138	100	72.4	—	—
100 "	145	98	67.5	6	4.1
	81830	44961	54.9	4864	5.5

Size	Total Number	Correct	Per cent.	D. R.	Per cent.
3 lt. P.P.	35069	23818	67.9	1101	3.1
3 lt.	44878	20710	46.1	2490	5.5
5 "	22297	12890	57.9	929	4.0
10 "	8231	5204	63.2	477	5.7
20 "	2333	1487	63.7	25	1.
30 "	747	545	71.5	11	1.4
45 "	497	383	77.	9	1.8
60 "	210	166	79.	3	1 4
100 "	252	173	68.6	6	2.3
	114514	65376	57.	5051	4.4

Size	Total Number	Correct	Per cent.	D. R.	Per cent.
3 lt. P.P.	48231	30686	63.	1181	2.
3 lt.	36865	16367	44.4	2001	5.1
5 "	19811	11384	57.4	996	5.1
10 "	6951	4383	63.0	311	4.6
20 "	1831	1140	62.3	30	1.6
30 "	656	479	73.0	8	1.
45 "	612	463	75.0	11	1.5
60 "	344	237	69.	3	.8
100 "	359	250	69.	1	.3
	115660	65389	56.	4542	3.9

Notwithstanding that various lengths of time have been determined upon by the gas companies and in some instances arbitrarily by Public Service Commissions, the number of meters changed for "age" usually is a comparatively small proportion of those which are brought in from the district.

The following table gives the reasons for 47,243 meters being brought in, there being only 15 per cent. of these removed for age test.

Reasons for being removed	Length of time on District											
	2 years		4 years		6 years		8 years		10 years		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Non-registering	340	3	525	4	629	10	320	9	1151	9	2965	6
Not passing gas	820	7	922	7	266	4	146	4	392	3	2546	5
Lights jumping	3469	27	4163	34	1264	21	760	21	2469	19	6741	25
Meter leaks	1648	13	1296	10	622	10	353	10	1231	9	5150	11
Dial glass broken	531	2	201	1	98	1	63	1	177	1	586	2
To please customer	66	—	52	—	31	-	29	—	51	—	229	—
P. P. in place of ordinary	314	2	267	2	92	1	51	1	138	1	862	2
P. P. trouble	1095	8	681	5	365	5	239	6	—	—	2380	4
Fire	34	—	27	—	21	—	10	—	61	—	153	—
Other size required	236	2	72	—	61	—	44	—	98	—	511	1
High bill	1	—	1	—	1	—	—	—	2	—	5	
Not in use	2901	23	3117	25	1671	27	920	26	1859	14	10846	22
Alterations to buildings	482	4	312	2	301	5	239	6	295	2	1629	3
For age test	575	5	589	5	605	10	351	10	5030	39	7150	15
Totals	12512	26	12225	25	6027	12	3525	7	12954	28	47243	9

This table also shows the reasons why certain meters are brought in after having remained for various years on the district. It will be noticed that the percentage of meters brought in for non-registering usually meets its maximum between five and six years and that an undesirable location of the meter also has a tendency to increase the number of non-registering meters. While on this subject of non-registering meters it might not be amiss to give statistics as to why meters fail to register, the following figures being the result of investigation of 558,413 meters, covering a period of more than seven years.

Cause of Non-registering	Number	Percentage
Diaphragms rotted	13,169	52
" porous by rubbing	926	3
" cut	246	1
Internal corrosion	4,521	17
Rusted	605	2
Cover arms bent	1,219	4
Cover wires broken	747	2
Crank frame broken	2,714	16
Bad handling	762	3
Defective construction	339	1
Defective repairs	160	—
Drilled	99	—
Total	25,487	—

The following table shows the results of a period of tests kept during six months of meters removed from service from a large eastern city for reasons that prepayment meters were desired by the consumers in place of ordinary meters in service or found in position and *vice versa.* This condition was about the same as would be brought about by going into the consumers' premises and removing and testing all meters found in position for the sole purpose of determining the error of registration of the entire number of meters in service. This investigation would have a tendency to show very nearly the true condition of the consumers' meters as a whole as shown; as is also the fact that the correct and slow meters are greatly in excess of the fast meters; that the fast meters tend to decrease and the slow meters to increase in proportion as the

number of years in service increase; that the average fast error does not increase with the length of service while the average slow error consistently increases during each succeeding year the meters are in service; and last, but not least, that the meters as a whole were slow from the first and gradually became slower with increasing years of service. These conditions would seem to leave but little cause for worry on the part of the consumer or any necessity for gas companies, public utility commissions or other legislative bodies to render decisions to change meters periodically with the idea of protecting the interests of the gas consumers.

TEST OF METERS REMOVED DURING A PERIOD OF 6 MONTHS CHANGE OF ORDINARY TO PREPAYMENT AND VICE VERSA.

Years in Service	Fast	Slow	* Correct	Won't Pass Gas
0–1	888	1030	1552	21
1–2	548	1044	961	33
2–3	403	868	570	27
3–4	254	640	414	22
4–5	157	441	250	12
5–6	119	346	133	13
6–7	80	246	86	4
7–°8	63	216	72	2
Total	2512	4831	4038	134

° Includes all meters removed that had been in service over 8 years.
* Those meters showing 0 proof,—no variation either way.

Cease to Record	Total	Avg.	Error—Per Cent. Avg. Fast	Avg. Slow	Avg. Net
22	3513	1.2	2.1	2.4	0.2(slow)
4	2590	1.7	2.3	2.9	0.7 "
3	1871	2.4	2.5	3.6	1.1 "
3	1333	2.3	2.7	3.6	1.3 "
3	863	2.6	2.3	4.2	1.7 "
1	612	3.0	2.7	4.3	1.9 "
1	428	3.3	3.3	4.5	2.1 "
3	355	3.6	2.8	5.1	2.6 "
40	11565	1.9	2.4	3.4	0.9 "

The "Won't Pass Gas" and the "Cease to Record" conditions of meters as shown in the above table were due to changes taking place inside of the meter as the result of the handling and shipping, and as a result of the time they stood after removal previous to receiving the proof tests, and to the fact that in many instances the meters had been shut off for long periods of time previous to their removal.

Judging from available data ten years would appear to be a sufficiently long enough period of time for any gas company to be satisfied to have its meters remain at a consumer's premises without having determined the proof of the meter, or to have offered the meter the protection against corrosion afforded by a good coating of paint. Gas companies that are not required to make periodical changes of meters in accordance with a period of years decided upon by some authority over which they have no jurisdiction, might well investigate this matter along the lines suggested—keeping a special record of tests of meters removed after having been in service for a period of between nine and ten years and, in the event of this term of years being too great, reducing the period to which the special record applies until a satisfactory term of years can be decided upon. Companies now working on a short term of years could change their policy in this respect and, as the time meters were permitted to remain in service, in consequence of this change in policy, increased, the tests of meters removed for cause could be tabulated according to years of service until a desirable maximum number of years the meters profitably could be left in service was decided upon.

Question No. 2.

Under What Conditions Should a Meter Which Has Been Brought in the Shop for Test be Allowed to be Reset Provided, of Course, That it Tests Satisfactorily?

Answers to this question were tabulated from companies operating 3,798,667 meters, as follows:

	Number of meters	Percentage
All meters to be examined thoroughly when brought in	1,123,413	30
To be reset after testing, proving and gasing satisfactorily	1,305,450	34
Length of time a meter may be allowed to remain on the district before having interior thoroughly examined:—		
2 years	68,263	2
3 years	39,273	1
4 years	144,000	3
6 years	118,258	3
10 years	1,000,000	27
Total	3,798,667	100

The practice of the various companies is so different as regards this subject that it is difficult to arrive at any definite conclusion from their answers. By referring to the table previously given in answer to Question No. 1, giving the causes of non-registering meters, it will be seen that a large percentage of these meters fail to register on account of the deterioration of the diaphragms and unless a thorough examination is made of the meter when it is brought in from the district the actual condition of the inside is not known and it is possible, and in a great many instances probable, that resetting a meter which has not had this examination will only lead to serious trouble in the future. Different gases produce different results on the action of the diaphragms. One thing, which is without a question one of the most important things to be considered by those companies making a practice of resetting meters that are brought in from the district, is the importance of capping the inlet and outlet of the meter when it is disconnected and not permitting air to come in contact with the interior mechanism of the meter. This matter, it appears, has been given very little attention in the past. Some gases leave a sticky condensate in the meters and as this condensate comes in contact with the air it causes the condensate to become thick, frequently causing the valves to drag and operate with difficulty, and sometimes sticking the leather of the diaphragms to the

side of the meter so as to cause it to tear when it is attempted to pass gas through the meter. With other kinds of gases the action is such as to remove the oil with which the diaphragms were originally treated and when the meter is removed and air admitted to the interior of the meter it frequently causes the leather of the diaphragm to shrink and become hard and stiff, thereby causing the meter to become what is known as a "fast meter" and sometimes to "fail to pass gas." In a great many instances conditions may be brought about which would be intermediate between these two extremes. It is unquestionably bad practice to remove a meter from the district and allow it to remain in the shop in an unused condition for any length of time before resetting. If the meter is to be reset it should be done as soon after the disconnection as possible and a minimum amount of air allowed to reach its interior.

In a large eastern city, the dipping meter diaphragms, as a whole, show marked deterioration after seven years of service. These seven-year diaphragms, however, are not deteriorated to the extent that they would not continue to give good additional service for a number of years in the vast majority of cases. There can be no doubt, but that there is a maximum length of time diaphragms should be permitted to remain in meters in service and, based on this maximum period, meters upon their removal from service for one cause or another should be opened. Following this line of thought, meters purchased and meters receiving new diaphragm repairs have been badged with the date of purchase or repair during the past two years in the above referred to city. At a subsequent time, all of the meters that have no date badge, or that have a date badge showing the diaphragms to be ten years old upon removal of the meters from service, will be sent to the meter repair shop to be opened up, regardless of the results of the meter room tests made at the time of such removal.

If the diaphragms in these meters are found to be in such condition, as a whole, to indicate that they would continue to give satisfactory service for a time longer, the limit will be raised to eleven years and so on until the safe maximum life

of diaphragms in meters removed from service is determined. In this way the meters will be maintained in the best possible condition with the least expenditure of money for new diaphragm, or clean and oil repairs.

It would seem as if the proper solution to this question would be for the superintendent of distribution to know the nature of his gas and its action on the meter and if the distribution and conditions are known it ought to be permissible to allow certain meters setting in good locations to be reset after having been on the district a comparatively short time without making a thorough and complete examination of the inside, but we do not believe it is practicable to make a definite and fixed rule, which will apply to all companies and all conditions.

Question No. 3.

How Long Should a Meter be Allowed to Remain at the Consumer's Premises in a Lock Off or Not Used Condition?

Answers were received to this question from companies operating 3,608,691 meters.

Number of Months in Service	Number of Meters	Percentage
1	268,000	7
2	182,319	5
3	39,283	1
6	2,445,126	68
7	24,143	1
9	118,258	3
12	151,562	4
24	380,000	11
Total	3,608,691	100

Opinion differs greatly as to the best policy to pursue in respect to the leaving of meters in position after the gas has been shut off. Some companies make a practice of removing meters at the time the supply of gas is discontinued, thus keeping down the stock of idle meters and the interest charges on any excess stock; preventing damages to the meters; saving

the cost of periodical visits of the meter readers to the meters shut off, and keeping the meters in better working condition, perhaps, by avoiding long periods of idleness. These savings are offset, or exceeded, however, by the costs of removing the meters, and resetting meters at such locations, in excess of the costs of shutting off and subsequently turning on the gas at such locations; the cost of testing meters upon removal from the consumers' premises, and the interest charges on the money spent in removing, testing, and resetting meters, which would have remained in position and had gas turned on again within a determined period of time.

Unquestionably the practice of allowing meters to remain on the premises for a limited time results in a saving to the gas company. The determination of the correct length of time to leave meters in position after the gas has been shut off is a comparatively simple one to work out in each particular situation. No general rule can be given for determining this period of time, however, but an investigation of the subject can be made at comparatively little trouble, or expense to determine the proper length of time to leave meter in position in each situation after the gas has been shut off. This period should be one in which the interest on the cost of the meters turned on within the specified period, the cost of a shut-off and of a turn-on for each such meter, and the expense incurred in visiting and in keeping ledger records of such meters during the period they were shut off is less than the cost of removing and of resetting the same number of meters, of testing this number of meters upon removal from service and the interest charges on these expenditures.

Comparative costs will work out differently in practically every situation, and these costs should be studied carefully in order to determine the maximum time to permit shut-off meters to remain in service without incurring additional expense by so doing.

Meters left in position with the gas shut off are subject to more severe conditions, both externally and internally than are the meters in service. The exterior is subject to greater

damage from accidents and rusting, the valves tend to stick, and in turn, to strain the flag arms and valve arms when gas is turned on, and the air which works back into the meters after the gas has been shut off has a tendency to hasten the deterioration of the leather diaphragms. The proper solution of the question requires an analytical study of the district conditions and necessitates taking into consideration the kind of gas used, the location of meters and the number of times the meters have been reset since receiving a thorough examination of their interior. In any case of doubt as to the proper maximum period of time to permit shut-off meters to remain connected on the consumers' premises, it is far better to err in favor of the shorter period than to decide on too long a period of time.

Question No. 4.

How Long Should Meters be Allowed to Remain in Service which Pass Very Large Amounts of Gas or which Supply a Fluctuating Load, as for Instance Gas Engines?

Answers to this question were received from companies operating 3,847,174 meters.

Number of Years in Service	Number of Meters	Percentage
1	575,363	15
2	1,678,341	43
3	38,396	14
5	531,562	1
7	1,023,512	27
Total	3,847,174	100

As the percentage of the number of meters which supply very large quantities of gas is comparatively small and as the amount of money involved in the sale of gas is considerable, it would seem to be a wise policy on the part of the gas company to pay close attention to such meter consumptions; the cost of examination is comparatively small in consideration of the amount that would be lost through neglect.

For many years after gas was first used commercially the

meters usually were subject only to intermittent operation. With the large increase in the amount of gas used for commercial purposes, meters are now beginning to operate continuously for much longer periods, and it would seem to be a wise policy on the part of the gas companies having such installations to pay close and careful attention to this condition, and to the length of time it is safe to allow such meters to remain before removing them.

Before deciding upon any definite short period of time, however, for changing these meters, it would be advisable to study the conditions in each situation. If meters are set with due consideration for the conditions under which they are expected to operate and meters of excess capacity are installed so as to prevent operation for long periods, at or near maximum rated hourly capacities, thus assuring reduced speed and a fair excess capacity, there should be no marked tendency for meters set to supply gas under the conditions stated in the question, to show unusual wear or develop serious slow errors in registration, and, in consequence, there should be no necessity for changing such meters more frequently than the meters are changed as a whole.

The cost of frequently changing large meters is a considerable item of expense and unless the saving effected by so doing in wiping out losses due to meters registering slow, offsets this expense there is no excuse for following such practice. With comparatively small effort, it should be possible for any company to keep a record of the proofs of meters removed periodically from locations where they had been set to supply large volumes of gas during long periods of time in order to determine the tendency of such meters to develop a net error slow within a stated period of time, and then compare their loss in revenue, due to this slow error, which, in all probability, developed gradually during the entire time the meters had been in operation, with the cost incurred in the changing, testing, repairing and other incidental costs brought about by this periodical changing of meters.

The proof tests of *all* large meters removed from service

during a period of five years, by one of the large eastern gas companies, showed the following net errors of the meters by sizes and according to the number of years of service of the meters at the locations from which they were removed:

	Number of years in Service	Net Error Per cent.	Cease to Record	Won't Pass Gas	Total Meters Removed
100 Light					
	0–1	0.20 fast	3	2	131
	1–2	0.60 "	3	4	93
	2–3	0.07 slow	2	1	96
	3–4	0.36 fast	3	2	98
	4–5	0.36 "	1	0	98
	5–6	0.70 "	1	0	49
	Totals	0.60 fast	13	9	565
150 Light					
	0–1	0.70 slow	1	0	42
	1–2	0.50 "	0	0	29
	2–3	0.00	0	0	32
	3–4	0.77 "	0	0	31
	4–5	0.90 "	0	1	34
	5–6	0.60 "	0	0	17
	Totals	0.50 slow	1	1	185
200 Light					
	0–1	2.8 slow	0	0	6
	1–2	0.5 "	0	0	6
	2–3	0.4 fast	0	0	9
	3–5	1.8 slow	0	0	5
	5–6	0.8 "	0	0	4
	Totals	0.90 slow	0	0	30
300 Light					
	0–1	0.70 slow	0	0	16
	1–2	0.70 fast	0	1	7
	2–3	0.20 slow	1	1	12
	3–4	0.80 "	0	0	17
	4–5	0.00	0	0	5
	5–6	0.20 "	0	0	1
	Totals	0.30 slow	1	2	58
60 A					
	0–1	1.2 slow	0	0	7
	1–2	0.5 "	0	0	3
	Totals	0.8 slow	0	0	10
150 A					
	0–1	1.1 slow	0	0	3
	1–2	2.9 "	0	0	1
	2–3	0.0	0	0	1
	Totals	1.3 slow	0	0	5

The above results were not obtained to show the condition of proof of meters that had been in operation for long periods of time passing gas at or near their maximum rated capacities. The net errors shown, however, indicate that the large meters as a class did not tend to become progressively slower year by year, neither did they develop slow net errors sufficiently large to warrant the changing of these meters upon a one or a two-year schedule, or upon any schedule other than the one applying to all meters at that time. If the record had been kept to show the proofs of those meters that supplied gas to gas engines and to industrial appliances consuming large volumes of gas, causing the meters to operate during long periods of time, it is possible that the net errors obtained would have been considerably slower, so that the removal of the meters set to supply gas under these special conditions might have been warranted upon a short schedule of years.

It would seem as if no general rule could be laid down to govern this subject, but that it could be best decided by careful study of local conditions.

Question No. 5.

What is the Best Maximum Size and Capacity of Meter Which Should be Used?

This question was asked just as it was received by the Committee and from the answers received it would indicate that it was differently interpreted by the various companies answering.

The following table shows the practice of companies operating 1,639,695 meters:

Size of Meter Recommended	Number of Meters	Percentage
60 B	283,297	17
100 B	858,140	52
150 A	498,258	31
Total	1,639,695	100

On account of the large number of installations of gas appliances for commercial purposes, some of which use gas

in very large quantities, there is a corresponding increase demand being made on gas meters for passing gas in greater quantities and more continuously and, having this condition in mind, it would seem as if it were advisable that the installation should have a capacity of from 25 to 50 per cent. more than the maximum demand on the meter. Moreover, in making installations where there is to be a large quantity of gas used, especially for commercial purposes, it would seem to be better practice to set several meters of the same size rather than to make the installation in one large unit, as, in case of a breakdown of any one meter the service is then not interrupted. In case the floor space will not permit of meters being arranged in batteries and it is necessary to make one large installation it would seem advisable to make a by-pass connection between the inlet and the outlet of the meter and install in this by-pass a lock cock so that in case of a breakdown the service may not be discontinued. The discontinuation of the gas in a large manufacturing or commercial plant during working hours is likely to cause serious inconvenience and considerable loss.

The question as to the schedule of sizes and the determination of the maximum size of meter included in such a schedule rests with the management of each gas company. It is not the province of this Committee to recommend any particular style or type of meter, but make certain suggestions and recommendations that would apply to all meters. It would seem desirable to have some meter schedule similar to the following, and further consideration of this subject is recommended.

1. The statement of the capacity of meters should be at a differential of 0.5 inch as all meters can be safely and satisfactorily used at this differential.

2. There is no advantage in having any two sizes whose capacities approach each other. Another objection to the narrow range between these capacities is that it will require too many sizes to cover the total range of capacities.

3. The smallest capacity recommended by the Committee is the 5-light meter.

4. Any standard of meters should contain not only a list of capacities, but also of the two important physical dimensions of the meters, *i. e.*, distance from bottom of meter to top of screws, and distance between screws, center to center.

The following is suggested as the standard rating:

Name	Capacity (a)	Height (b)	Width (c)	Depth (d)	Size Screw

(*a*) With 0.5 inch differential and a gas with specific gravity of 0.55.

(*b*) In inches from bottom of meter to top of screw.

(*c*) In inches from center to center of screws.

(*d*) Depth front to back case.

Suggestions have been made to the Committee as follows:

That badges showing the number, manufacturer and capacity of the meter be placed on the gallery instead of the front case.

It has been the practice in the past for manufacturers to rate meters under the conditions of "clean valves" and "very carefully packed stuffing boxes." These capacities cannot always be obtained in service under the same differential pressure and suggestion has been made that no meter be badged to show more than 80 per cent. of the maximum capacity under a 0.5 inch differential pressure.

Question No. 6.

Where Meters are Set in Batteries, What is the Best Arrangement?

This question seems to have been differently interpreted by the various gas companies answering. This subject might properly be divided into two classes. The first, where the

service has to supply a large apartment house and a large number of meters are required to be set from the same service; the other, where several meters are to be set in parallel, or batteries to supply a large commercial plant.

In installing a service to take care of an apartment house care should be taken so that the number of meters and the house line requirements will not exceed, even at their greatest maximum, the carrying capacity of the service. It is desirable to extend the service the full size over all the meters. It is also important that a meter cock, preferably one of the locking type, should be placed on the inlet of every meter.

As regards the installation of meters for large commercial purposes, service should be extended full size up to the last unit; the meters should be set in parallel and preferably a straight-way wheel valve placed at the inlet and outlet of each meter, so that any one meter may be removed from the installation without affecting the action of the others.

In order to determine with certainty that both valves have been closed before attempting to break the meter unions, or flanged joints preparatory to removing a meter set in parallel, a small screw plug, placed in the outlet connection between the meter and the outlet valve, should be removed and the pressure conditions noted.

Under no conditions should prepayment meters be set in parallel to supply gas to a consumer.

Meters set in parallel ordinarily will not pass gas in equal proportions, owing to the difference in resistance offered by the meters in their operation; one or more meters passing only a small proportion of the gas consumed through the battery. In order that this condition may be remedied, the outlet valves should be manipulated so as to restrict the flow through certain meters and to cause the inactive or lazy meters in the battery to pass their proper proportions, thus preventing excessive wear on the meters that otherwise would be overworked. The inlet valve should always be left fully open. These conditions could easily be kept track of by the ledger clerks, and the necessary instructions issued from time to time

to make certain adjustment of outlet valves. If this was not thought advisable, then the proposition of removing those meters in a battery which were being overworked, as indicated by the excessively high registration, during stated periods, should be given some thought.

In those cases where the maximum hourly demand exceeds the safe working capacity of the largest meter carried in stock, or where there is not sufficient space in which to set the large meter, or when necessary to set large meters high above the floor, the remedy is to get smaller meters of excess total capacity in parallel to supply a common header.

The practice in some towns is to run by-pass connections, fitted with locked wheel valves between the inlet and outlet meter piping when single meters are set to supply gas under conditions that brook of no possibility of interruption of the gas supply; as in newspaper offices where linotype machines are used; in industrial plants where continuous heats are required; in bakeries, etc. The installation of a battery of meters in such cases would obviate the necessity for the by-pass and, in the long run, probably would entail no more expense than would be entailed by the setting of the single large meter.

Question No. 7.

What is the Best Practice in Removing Meters with Regard to the Rigid Connections and Shelves? That is, Should They, Under Ordinary Conditions, be Left Intact, or Should They be Brought in with the Meter?

As regards this subject the practice is quite varied, as the following table shows:

Practice	Number of Meters	Percentage
Connections and shelves not removed	1,102,602	24
Connections and shelves removed	2,473,566	53
Connections removed, shelves not removed	495,258	11
Connections not removed	375,703	8
Connections not removed, shelves removed	151,562	4
Total	4,598,691	100

It would seem as if answers relative to this practice would indicate that it did not make any material difference whether the shelves or connections were left in or not, it being a matter to be decided by local conditions. It is probably advisable to have the practice vary in the different sections of the same city.

In those situations where a tie-in device is used between the meter inlet and outlet connections, the adjustment of which depend upon lengthening or shortening of the members of the tie-in device to enable proper facing of the swivels with the meter screws each time the meter is changed, the tie-in connection should be removed at the time of removing the meter. This practice not only keeps down the total investment in this more expensive type of tie-in connection, but does not entail any extra work on the part of the meter setters, inasmuch as, under any conditions, the tie-in connection should be removed and adjusted to the meter to be set and then replaced in position on the meter connections.

It would seem as if this were a subject which could be better decided locally than by following any general rule.

Question No. 8.

Notes in Regard to Instructions as to the Handling of Meters by Fitters and also on Wagons.

Meters should be kept in an upright position at all times. The one exception to this rule being in the case of prepayment meters, which occasionally have to be tilted to the inlet side in order to remove any liquid that has accumulated in the trapped long channel of the closed top type of meter.

Condensation may be removed from side pipes or meter columns by means of small pumps designed for the purpose.

Meters should not be dropped, nor tossed from one man to another, nor slid along rough floors or sidewalks. The weight of the meter should not be thrown on a bottom corner, as this is a pretty sure means of starting corner leaks.

Meters should not be left on the sidewalks, nor left in wagons in position to be easily stolen.

Meters should have the meter screws tightly capped at all times when not set at the consumers' premises. This capping should be of a nature to insure protection to the threads of the meter screws as well as to prevent leakage of air into the meter.

The paint on the meters should be protected from abrasion by means of suitable pads, padded shelves, or padded boxes. If convenient means could be found for touching up the meters after they had been set, considerable rusting of the outside tinned surface of the meters would be avoided.

Suitable means should be provided for keeping meters from falling off the shelves in the meter wagons, or from being jolted together. When meters are carried on side shelves in meter wagons, a pair of straps should be provided for the purpose of keeping each meter in position independent of its neighbor.

Do not pile miscellaneous fittings or appliances on, or against, the meters during delivery.

Do not start out with a meter wagon in need of repairs. Avoid crossing car tracks, or rough stretches of roads at high speed.

Meters damaged in any way should never be set but returned to shop.

These instructions apply equally to old meters upon their removal from service, as they do to meters taken out to be set.

Question No. 9.

What is the Best Practice in Shutting Off the Gas when Service is Discontinued? For Instance, is it Better to Shut the Gas Off at the Curb or at the Lock Cock, or is it Best to Insert a Blind Washer in the Union?

The following table gives the best analysis that can be derived from the answers given:

Practice	Number of meters	Percentage
Shut off at meter cock	2,582,647	66
Shut off meter at curb	781,143	20
Either blind washer or some similar seal	524,000	14
Total	3,887,790	100

If there are several meters in the building unquestionably the best method to discontinue the supply of gas is to shut off the gas at the meter cocks, preferably lock cocks. It would seem as though lock cocks should have the preference to other styles of cocks as the lugs for locking only add about 5 per cent. to the cost of the cock. When lock cocks are not used a blind washer or plain swivel serves the purpose.

Question No. 10.

What are Some of the Weak Points of Some of the Best Rigid Couplings and Meter Shelves?

While progress is being made in the use of the rigid meter connection it would seem as though the greater portion of the gas companies to whom questions were sent are still not using this type of meter support.

Practice	Number of Meters	Percentage
Not using rigid couplings and shelves	2,421,625	71
Using rigid couplings and shelves	1,006,988	29
Total	3,428,613	100

Some of the criticisms of the rigid couplings are as follows:

One of the troubles with the rigid connection was that the holes were tapped crooked; this, of course, prevented the meter unions from facing up properly.

There seems to be a decided opinion that the rigid connection has a tendency to bring a strain on the meter unless great care is taken when the meter is set to face up the joints properly. Also, attention is called to the greater number of joints in the connection with a great chance of leaks occurring.

Question No. 11.

Notes Containing a Caution to Those Setting Meters to Make Sure that the Outlet Riser is Firmly Fastened to a Permanent Part of the Building.

Practice	Number of Meters	Percentage
Not answered	480,901	10
Support not required	73,319	1.5
Support required	4,054,471	88.5
Total	4,608,691	100

It would seem as if this matter about which there should be no doubt as to the practice to be pursued can only be given one answer—that is, the house riser should be so securely fastened as to have none of its weight resting on the meter and there should be no liability of its sagging or dropping down should the meter be removed.

Question No. 12.

Table of Don'ts Showing Where and Under What Conditions a Meter Should be Set.

We think that this question is fairly well covered by the Committee on Housepiping. However, it may not be amiss to mention a few of the places where a meter should not be set. There are some rules for the setting of meters that are apparently so necessary to conform to or rather not to conform to that it hardly seems necessary to make rules governing them—such as the desirability of not setting meters in cold or drafty places, or rooms where there are sudden and extreme changes of temperature, or where they are liable to be in the way and easily damaged. It is undesirable to set meters in bathrooms, coal bins, slaughter houses, stables or ice cream manufacturing plants. Meters setting in the three latter locations should receive frequent inspection as the fumes of the gases are such as to cause the meter to rust out and deteriorate in a comparatively short time.

A greater part of the condensate which accumulates in the meter seems to be due to the fact that the meter acts to a certain extent as a condenser, the interior channels of the meter forming traps. If the condensate which accumulates in the meter came from either the service or house pipes the fact that this trap occurring in the meter would cause the trouble to be brought to the attention of the gas companies very much sooner than it does. This would indicate that the accumulation of condensate is due to the action of the meter as a condenser. Consequently, the meter should not be placed

where either the front or the back is subject to drafts or extreme variations in temperature.

Respectfully submitted,

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W. A. Castor,
L. B. Elliott,
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The Chairman: The Committee has worked very hard, has done very good work, and they will be glad to answer any questions. If no questions are asked, they have the right to assume that we know all about the gas meter. Personally, I do not believe we all do—for instance, we would like the Committee to tell us more clearly how long meters supplying large industrial consumers should remain in service. Certainly this period should not depend solely on the length of time that the meter has been in use. It seems to me that it would be better to set a limit as to the number of cubic feet of gas each size meter should pass, and then remove the meter when the register shows this amount of gas to have been consumed. Consideration, of course, should also be given to the character of the load. A meter supplying gas for a gas engine, for instance, should be changed more frequently than one supplying a load that is more or less steady. I would suggest that the Committee on Consumers' Meters for next year give this matter some consideration.

We have a lengthy and very interesting discussion of the report by Mr. Walton Forstall, which will be published in the Proceedings at this point.

Mr. Walton Forstall: (Written discussion communicated.) The table of dimensions of standard meter unions, as given on page 862, I do not consider as furnishing sufficient data from which standard unions could be made. Therefore, I

suggest that the Committee incorporate in its report as printed, detail drawings of the unions.

Believing that the value of the Committee's report would be increased by an amplification of the answers it has made to the various questions, I offer what follows:

Question No. 1.

How often should a meter be brought in for test?

Meters should be removed for periodical test only after they have so changed in proof as to warrant their removal in order to protect the interests of the consumers or of the gas company. The logical method of determining the maximum change period is to tabulate the proof test errors, expressed in percentages, of which each meter was last removed. The proof tests should be obtained the following working day after removal, the meters in the meanwhile being kept tightly capped and in the room in which they are to be tested. This tabulation can be carried out to advantage only in those situations where meters are not changed at present in accordance with some short term of years arbitrarily decided upon by either the gas company or by state or municipal regulation.

Meters in service do not become faster, or slower, consistently, as time goes on, but the same meter may register a little fast this month, or a little slow the following month, or the degree of error may vary from time to time. This is true of practically every dry type of meter in service, the variations being due to a number of causes. The displacement spaces of the meter, being enclosed by leather, are responsible to a very large extent for these conditions—the leather is affected in its flexibility and in its stretching and shrinking, by the temperature of the gas passing through the meter, and by the nature and quantity of liquid retained in the leather. In situations where manufactured illuminating gas is distributed, the tendency, however, is for the meters to become slower in proof as their years in service increase. This tendency does not become marked until the diaphragms begin to deteriorate, internal leaks develop, or the valves become gummed up or

lumpy; the length of time required in which to develop any such marked tendency being in excess of the periodical change periods usually decided upon.

Records of meter tests of numerous gas companies, both large and small, tend to show that the consumer has no real cause for apprehension as to the probability of the gas meters registering in favor of the company. There always will be a limited number of meters, however, which, will through defects developing in the working parts, or through other causes, register in excess of the actual volumes of gas passed. This condition is not so much dependent upon the length of time the meters are permitted to remain in service, as it is upon weaknesses in the meters originally. The tendency of these few meters to register against the consumer, develops during the first year or so they are in service, and result in their being removed for cause, such as "high bill," "to satisfy consumer," etc., rather than for any periodical change.

The following is a summary of the test of meters made during the past 2 years by city officials in a large gas situation, upon the request of consumers who believed the meter, in each case, was registering greatly in excess of the gas actually passed through it:

	1914	1915
Meters removed for city test	126	113
Number of fast meters	44	67
Number of slow meters	79	41
*Number of correct meters	3	5
Percentage of slow and correct meters	65	40
Total fast error (per cent.)	75.1	161.7
Total slow error (per cent.)	228.6	131.6
Average fast error (per cent.)	1.71	2.41
Average slow error "	2.89	3.21
Average error "	2.41	2.60
Average net error "	1.22 (slow)	0.27 (fast)
Meters fast less than 3 per cent.	37	48
" " more " 3 "	7	19
" slow less " 3 "	51	24
" " more " 3 "	28	17

* Correct meters were those which did not show any variation in proof either way.

Meter tests, as recorded by a gas company, misrepresent the condition of the great bulk of meters in actual service, inasmuch as these tests are, in most cases, of meters removed for cause, and consequently indicate a worse condition of proof than will be true of the meters as a whole, hence the table on page 873 is important.

After a study of this table, it should be clear that the consumers require no protection against the possibility of increasing fast registration as the years in service increase, but that it is essential for the gas companies to protect their own and their consumers' interests, by deciding upon the safe maximum period for meters as a whole to remain in service. This determination must be based upon the cost of changing, testing and repairing meters removed on an age-in-service basis, as compared with the loss in revenue resulting from the average net error slow of such meters in service.

For example, let us assume that meters in service for a period of between 7 and 8 years show an average net error of 4 per cent. slow upon removal under ordinary conditions, and that the average revenue derived from such meters was $25.00 per annum. In this case, the gas company would lose 4/96th of $25.00, $1.04 per year per consumer, and this loss in revenue probably would continue in increasing amounts each year until the meter was removed. The average cost of changing, testing, repairing, etc., per meter removed from service after 7 years of service, we will say is $1.75. At first glance, it would appear to be good practice to remove the meters under the conditions stated, inasmuch as the loss in revenue is $1.04 or more each year the meter remains in service; however, this loss will not be a net loss to the company, the actual loss being the cost of the gas delivered but not registered on the meter index, and the interest on the larger distribution system necessitated to carry the volumes of gas delivered but not registered. The meter removed on the 7-year basis might have been left safely in service for a longer period of years, without requiring any more extensive repairs when removed at the end of the longer period, and

in this way the maximum return would be obtained for money expended in the changing, testing and repairing of meters.

Question No. 2.

Under what conditions should a meter which has been brought to the shop for test, be allowed to be reset, provided, of course, that it tests satisfactorily?

Ordinarily, meters that pass the prover test, and which do not show marked fluctuation in outlet pressure when passing gas, or air, at about the check test rate of flow, and which do not fail to register on the small flame test, or on the burner test, may be returned to service after any necessary adjustment of proof has been made.

Meters that show an error of over 10 per cent., or, in some localities, of over 6 per cent., either way, upon removal should be opened and have the diaphragms examined, inasmuch as such meters are pretty sure to be in need of extensive repairs.

In large situations where the life of the diaphragms in the meters removed from service can be determined readily, and a study can be made of the condition of the diaphragms according to their age, it probably is good practice to determine upon a maximum life of the diaphragms which warrants the opening of the meters for the purpose of making an examination of such diaphragms.

No maximum time can be set for this examination in each situation, inasmuch as the condensation thrown down in the meters does not affect the diaphragms to the same extent in each situation.

Question No. 3.

How long should a meter be allowed to remain on consumer's premises in a locked-off or not-used condition?

Let us assume the cost of a meter to be $8.00, interest rates 6 per cent. per annum, and the cost of damages to meters shut off for an average period of 1 year, including set and remove costs and cost of testing, to be 15 cents per meter, and that each meter was visited monthly by the meter reader, and

record of such visits kept in the consumers' ledgers costing 25 cents during the year; the expense incurred by the company if gas was turned on at the end of the year, in comparison with the removal of the meter at the time the gas was shut off, would be about as follows:

Meters Shut off for One Year and Then Turned On.

Shut off and turn on costs	$ 0.22
Cost of monthly visits, etc	0.25
Average damage cost per meter	0.15
6% interest on $8.00	0.48
Total expense	$ 1.10

Meters removed at time of shut off and then re-set.

Cost of removing and re-setting	$ 1.10
Testing costs	0.15
Total expense	$ 1.25

Under these conditions, it would be unprofitable to permit the meters to remain in position for a period of slightly longer than 1 year.

Using the above figures, meters removed at the expiration of 1 year after the shut off would cost the company about $1.73, as compared with a cost of $0.74 for removing the meter at the time of making the shut off, and not resetting a meter at the remove address.

In Philadelphia the original practice was to remove meters after they have been shut off for a period of 6 months. This time limit was raised to 13 months for ordinary meters and later for prepayment meters also. About 4 years ago the limit was raised to 2 years for both prepayment and ordinary meters. The damage to meters left on the consumers' premises shut off for this period of time is not excessive, the meters do not develop any great percentages of stuck valves during this period, and examination of the diaphragms in meters removed after having been shut off for the 2-year term, shows there is no decided tendency for them to deteriorate more rapidly than do the diaphragms in meters in continuous service for similar periods of time.

Question No. 4.

How long should meters be allowed to remain in service which pass very large amounts of gas, or which supply a fluctuating load, as, for instance, gas engines?

Many gas companies pay special attention to meters set to supply gas under conditions covered by the question. The general rule adopted by one large company operating a number of smaller companies is to change *all* meters, 60-light and larger, at least once each year. The most common practice in this respect, however, appears to be that of annually changing large meters set to supply gas for long continuous periods of time at or near their rated capacities, and meters set to supply gas engines.

Theoretically, this is good practice, as it is only to be expected that meters working day after day, for long hours, or at close to their safe capacity, passing large volumes of gas in comparatively short periods of time, and also meters under similar conditions but operating at constantly varying speeds, or we might say, in jerks to supply gas engines, will develop strains, defects and wear to greater extent than will meters used under ordinary service conditions. As practically all wear of moving parts, and all internal leaks that develop in meters, and that do not prevent operation, result in slow errors, and as meters operating under the conditions covered, pass very much greater volumes of gas in the same period of time than do the general run of meters, it behooves the gas companies to change these meters before they develop any decided slow error.

Question No. 5.

What is the best maximum size and capacity of meter which should be used?

The use of the older types of large meters, especially those fitted with side flanges, entails considerable expense in their handling, hauling, setting and upkeep in excess of the expense incurred in the use of the more modern type of large meter having comparatively small outside dimensions; their capaci-

ties, however, being equal to, or in excess of, the meters of the larger outside dimensions.

In situations where meters of 200, 250 and 300 light sizes are in stock, it probably is good practice to keep these meters active, or at least not to condemn them until extensive repairs are necessitated, such as new diaphragm repairs, when in order to have such repairs made it is necessary to crate, pay freight and handling charges, and the profit charged by the outside repair shop, in addition to paying for extra repairs pretty certain to be required to these larger meters after they have seen long years of service, and have been subjected to the strains and damages incident to their removal, hauling and shipping. Gas companies with their own meter repair shops can afford indefinitely to make new diaphragm repairs to old meters as large as 300 light, and pay the extra costs of hauling and setting, in comparison with the purchase and installation costs, meters of equal capacity fitted with screw connections and of considerably smaller outside measurements. In order to warrant the making of these extensive repairs of large meters, especially of the flanged type, it is essential that the cost of the repairs, together with the cost of hauling and of making up the large flanged meter connections, in excess of the cost of the same work on the smallest size large capacity meter that would answer in each case, does not exceed about 60 or 65 per cent. of the purchase price of a new large capacity meter.

For example, let us assume that the excess cost to a gas company not doing its own meter repair work, of new diaphragm repairs to a 300-light meter in excess of the cost of similar repairs to a 150-A meter, including hauling and freight charges, is $37.00. Also, that the extra cost of hauling and setting a 300-light meter in comparison with a 150-A meter, is $3.50; that the life of the diaphragms in each size of meter is 10 years, would it be profitable to have new diaphragm repairs made to the 300-light meter at the present time, and again 10 years hence, rather than to purchase a new 150-A meter at the present time?

1 150-A meter	$100.00
Interest at 6% for 10 years	60.00
Total cost of investment	$160.00
New diaphragm repairs to 300-light meter excess cost including freight, etc	$ 37.00
Excess cost of connecting 300-light meter	3.50
Interest at 6% for 10 years on $40.50	24.30
Excessive cost of connecting 300-light meter 5 years later	3.50
Interest at 6% for 5 years on $3.50	1.05
Excess cost of setting 300-light meter at end of 10 years	3.50
Excess cost of N. D. repairs, etc., at end of 10 years	37.00
Total expense during 10-year period	$109.85

No interest charge on the cost of the 300-light meter is shown, for the reason that the use of this meter, already paid for, does away with the necessity of making the investment required for the purchase of a new 150-A meter. The above example would seem to indicate that unless expensive repairs were made to the 300-light meter, in addition to the needed new diaphragm repairs, it would be good policy to repair the 300-light meters with two sets of new diaphragms, thereby obtaining 20 or 25 years additional service from these meters, rather than to purchase new enlarged capacity meters the first time 300-light meters, owned at this time, required new diaphragm repairs.

Under any conditions, consumers' meters larger than the 300-light size should be condemned, rather than attempt to make new diaphragm repairs to them.

Question No. 6.

Where meters are set in batteries, what is the best arrangement?

Meters set in parallel should be set on suitable blocking placed on the floor or on low tables provided for the purpose, and should have meter cocks or wheel valves on the inlet and on the outlet connection of each meter included in the bat-

tery. A sufficient number of swing joints should be provided to enable the meter unions or meter flange connections to face up when meters of varying heights and widths are necessarily employed in meter change work.

Question No. 7.

What is the best practice in removing meters with regard to the rigid connections and shelves—that is, should they, under ordinary conditions, be left intact, or should they be brought in with the meter?

Rigid meter tie-in connections depending upon offset swivels to provide means for adjusting the position of the meter unions for variable widths between centers of meter screws, should be left in position when removing meters, unless it is evident that gas will not be used again at the location in question. This practice is advisable, inasmuch as the tie-in connections of this type are not expensive; consequently the total money invested in the connections left at locations from which the meters may have been removed, is not large. Further, the tie-in connection, when left in position, will tend to prevent theft of the entire meter connection, or of fittings and nipples, by plumbers or other people working at the premises or in the neighborhood, and will enable the gas company's fitter to save time which otherwise would be consumed in the removal and replacing of these connections. The exception to this practice would be in those situations where meters are permitted to remain in position for a long time, say 2 years, after the gas had been shut off. In these cases, it probably would be good practice to remove the solid tie-in connections at the time of removing the meter.

Meter shelves should be brought in when meters are removed from service, and no meters reset at the same location, provided the shelves, or supports, are easily removed, and are capable of being used again, and also in those cases where the shelf, or support, would form an accident hazard if not removed along with the meter.

Question No. 9.

What is the best practice of shutting off the gas when service is discontinued?

Where service cocks are installed, it is the general practice to shut the gas off at the curb and at the meter cock. Under these conditions there is no need for inserting a plugged swivel or a blind washer at the meter inlet.

In those situations where curb cocks are not installed, it is advisable to use lock cocks on the meter inlet connections, and if thought necessary to use blind swivels or washers at the meter inlet in addition when service is discontinued.

If more than one meter is supplied from the same service, the gas can be shut off from any one meter by means of the meter cock on the inlet connections to the meter in question. In this case, it is advisable to use a plugged swivel at the inlet union of the meter shut off. These plugged swivels may be painted red, to distinguish them from the open swivels.

When a battery of meters is shut off, the curb cock or valve should be closed as well as the cock or valve on the inlet and outlet connection of each meter.

The meter unions should be removed from the inlet and outlet connection, especially if they are of brass, at the time of removing a meter, and the open ends of the inlet and outlet piping connections should be closed by means of screw plugs.

Question No. 10.

What are the weak points of some of the best meter rigid couplings and meter shelves?

The solid tie-connection of the type which depends upon the use of offset swivels to give the adjustment necessitated by the variable widths between meter screws on meters of the same nominal size, is not satisfactory, inasmuch as it will not afford the necessary adjustment of the offset swivels to enable them to face up properly with the meter screws.

The improper facing results in washer joint leaks, and unwarranted straining of the meter screw sweated joints.

The type of tie-in connection consisting of two adjustable

members bolted together with rocker plates between, is scientifically and mechanically well designed and constructed, and answers every requirement desired of a tie-in connection. The method of supporting the meter by means of hangers suspended from eyes cast in these connections, thus providing means for clamping a narrow board against the bottom of the meter and parallel with the meter partition, affords the ideal method of positive meter support. The one drawback to the use of this type of connection is the necessity of removing it from position in order to adjust it to the meter every time a meter is changed. In practice it has been found that the fitters in some cases will not take the time to do this but will loosen up the bolts and attempt to adjust the tie-in connection in position on the piping connections. This results in improper facing of the meter swivels and meter screws in many cases. The fitter occasionally neglects to tighten the bolts holding the two members together; and by so doing defeats the object of the tie-in connection.

There can be no doubt but that tin meters should be properly supported when set in service, in order to relieve the meter screws of all strain as far as possible. If meters were set on connections that were properly run in the first place, and which were not subject to change from one cause or another, and the meters were not disconnected in order to make certain tests, or to insert blind swivels or new washers from the time they were set until they were removed, the need for meter shelves for meter support would not be so urgent. Most of the meter shelves available to gas companies in the past have been wooden brackets, or some form of supporting arm attached to a backboard which had to be attached to a wall. The wooden bracket shelves have been universally abandoned owing to the rusting out of the meter bottoms when these wooden shelves were used. Most of the supporting arm shelves failed to offer any support to the meter, owing to the absence of any means of adjusting the arms to the bottoms of the meters and the difficulty experienced in securing the backboards to the walls in a permanent manner. The Spangenberg two-piece ad-

justable shelf is the best type of meter shelf attached to a backboard that has been devised, but it is not entirely satisfactory, inasmuch as the adjustment cannot be made easily or satisfactorily, and the two-piece brackets are mounted on a backboard which may, or may not, be securely attached to the wall.

An investigation made by a large gas company a few years ago showed that about 21 per cent. of the meters in service were not afforded support by the meter shelves. Of this 21 per cent. of unsupported meters, 14 per cent. had wooden brackets in position under the meters; 48 per cent. had shelves consisting of a board attached to the wall and from which two sheet iron wings projected; 31 per cent. had the Spangenberg two-piece adjustable shelf, and 7 per cent. had no shelf in position beneath the meters. An investigation of the meter work done by the same company during the year 1915 showed that about 4 per cent. of the meters set, or changed, were not supported by the meter shelves; the inspections being made within 4 days after completion of the work. About 10 per cent. of all the work done by the meter setters was found to be defective in some respect; about 37 per cent. of these defects being due to improper placing of meter shelves, all of which were of the Spangenberg adjustable type.

The hanger type of shelf, referred to above, answers all the requirements of a perfect meter support. The threaded adjustment of the board supporting the meter permits of the meter being clamped securely to the meter unions at all times, and enables the meter to be lowered sufficiently to permit it to be swung far enough to clear either the inlet or outlet swivel, without straining the meter screw or the washer joint not disconnected at the time.

If some convenient means can be provided for attaching the galvanized hanger rods to the piping connections in the proper locations, when no tie-in connections are used, this type of meter support will, undoubtedly, supplant all other forms of meter support in use at this time, for meters as large as the 60-light size.

Question No. 11.

Caution to those setting meters to make sure that the outlet riser is firmly fastened to a permanent part of the building.

The question naturally arises, "What is a permanent part of the building?"

The walls probably are the most permanent part of any building, but in the event of an extensive fire they are as apt to buckle or to fall as the ordinary partition is to be burned out completely, and thus permit the riser to sag or to fall.

In everyday practice there is no need for the fitter to give this question any consideration, except to be sure that the house riser and the meter outlet piping connections are secured to the wall, partition, joint, or ceiling in a satisfactory manner to relieve the meter of all weight and vibration which it otherwise would be subjected to.

In cold localities, the practice is to keep the house riser away from the walls of buildings, and to run it up through partitions. This undoubtedly is good practice and one which should not be affected by the rare possibility of a partition burning out and causing the house riser to drop.

Question No. 12.

Give a table of "Don'ts" showing where and under what conditions a meter should not be set.

Don't set a meter where it will necessitate damage to other structures. Under no conditions attempt to remove or to relocate electric meters, electric wiring, conduits, water meters, or the property of any other company, in order to set a meter.

Don't break electric ground wires in changing or relocating a meter.

Don't attempt to set a meter against the wishes of the occupant.

Don't enter a furnished house in the absence of the occupants, unless some authorized representative of the owner or occupant is present.

Don't enter a house in which there is a contagious disease. If absolutely necessary to enter a house under these conditions to set or to remove a meter, enter through a cellar window or cellar door, and upon leaving the premises blow the nose thoroughly and immediately gargle the throat and nose with Listerine or some other antiseptic wash.

Don't open the service cock without first having inspected the conditions in the premises between the head of the service and the meter location.

Don't loosen the plug in the meter cock and leave it in this condition.

Don't shut off the gas supply to other consumers without first obtaining their consent.

Don't cut off the gas supply to other tenants and then restore it without first notifying the consumers affected, and then observing all turn-on precautions before turning gas into each system of piping.

Don't set a meter on a leaking system of house piping. Before turning gas into a system of house piping, the system should be tested for tightness, either by means of a pressure gauge or by means of the meter. In the event of testing the system by means of the meter, the meter should first be tested to determine if it will register under the passage of a small volume of gas. This may be accomplished by placing a cap on the meter outlet screw, which will permit of the passage of about 2 cubic feet of gas per hour, and watching the meter test hand for a specified time to detect a movement of the hand. If the meter test hand shows a movement, the meter may be connected to the piping system and the test hand again watched for a movement after turning on the gas.

Don't gas up a system of house piping through an open outlet.

Don't set up a meter on defective or improperly constructed piping connections. Connections which subject the meter screws and columns to strains, or which will not permit of

the proper facing of the meter screws and swivels, are certain to bring about meter leaks. Do not depend on the washers in improperly faced union joints to maintain gas-tight joints.

Don't strain old services when running inlet piping connections.

Don't leave an odor of gas behind you.

Don't use lead connections on header work.

Don't drain inlet piping into the meter inlet column.

Don't set prepayment meters in parallel, or in batteries, or to supply instantaneous water heaters, depending upon a pilot light for ignition of the gas issuing at the large burners.

Don't set meters close to cellar walls, in an inclined position, or without providing suitable support for the meter.

Don't set a meter near a furnace or oven, or in a location where the temperature of the surrounding air is liable to be changed rapidly, or where it is liable to be injured by steam, acid fumes or dampness. Do not set a meter in a locked closet, or in a locked compartment, under steps or in locations where it is inconvenient to reach or to read the index, or in a location where the inlet piping will be covered with plaster or casing.

Don't set a meter if you are reasonably sure that it is too small to supply the volume of gas required by the consumer.

Don't set a prepayment meter in such a location that the cash box will be visible from the street, or where a thief can have easy access to it from the street.

THE CHAIRMAN: We will now have the paper on "Manufactured Gas for House Heating," by Mr. Geo. S. Barrows and Mr. C. C. Winterstein. Mr. Barrows will present the paper.

MANUFACTURED GAS FOR HOUSE HEATING.

When the Chairman of the Papers' Committee requested the preparation of this paper he expressed the hope "that it will not include the usual statement that the price of gas

prevents its use for general house heating." This request seems to indicate that some such statement has been made as an excuse for an infrequent use of gas as fuel for house heating purposes. We propose to ascertain the validity of such an excuse by a discussion of the theoretical aspects rather than by a consideration of the pracical appliances, the design of which, with our present knowledge of combustion and heat transference, should be relatively simple once we are sure of the fundamental principles. Treating the subject in this manner it is not enough to speak of gas alone, for the result desired by the consumer is heat and all means for obtaining it must be considered. Current periodicals and literature on the subject of house heating indicate but little careful study of the use of manufactured gas for house heating and it appears as if it is categorically assumed that it is out of the question. For this trend of opinion we may be to blame for insufficient publicity as is indicated by a recent edition of a handbook on Heating and Ventilation, published by a well known engineer, in which the author has found it pertinent to add a short chapter on electrical heating and has made therein an approximate computation of the relative costs of electrical and coal heating. No similar comment, however, is to be found regarding the relative costs of gas and coal heating and the thought naturally arises, therefore, as to what the motive could have been which impelled this authority to span the breach between these two widely different methods of house heating while entirely ignoring the fuel 'gas.' It would seem that the electrical industry, despite obvious obstacles, has been able to demand a hearing in the consideration of this topic while the more logical fuel 'gas,' and we refer here to manufactured gas in particular, has failed to make a very deep impression.

As the reports of committees to, and papers before the Institute go to all of our members and reports and papers of the National Commercial Gas Association are readily available to those of us who are not members of that Association, we, believing it highly desirable to limit the length of this

paper and avoid duplication, will not include herein matter which may be found elsewhere but will make such reference as will be necessary to find the originals.

Kinds of Fuel—Sources of Heat.

1st Manufactured Gas.

2nd. Natural Gas.

As the object of this paper is to show the propriety of using manufactured gas as fuel we need make no reference to natural gas other than to emphasize its proven utility for house-heating purposes and state that because of its relatively high thermal value and low cost and the methods of application established by custom it is uncomparable with manufactured gas.

3rd. Anthracite Coal.

The standard fuel for house-heating in the northern and eastern states.

4th. Bituminous Coal.

The standard fuel for house-heating in those states where anthracite is not readily available.

5th. Coke.

A fuel which while steading growing in favor cannot be said to be yet in common use.

6th. Oil.

Of the grades commonly known as "Fuel Oil" is in use in some parts of the country where it is readily accessible.

7th. Wood.

Is only used for auxiliary heating in those communities where manufactured gas is available.

8th. District Heating.

Where the heating medium (steam or hot water) is supplied to several houses in a neighborhood from a common generating station.

9th. Electricity.

At the present time to be looked on as a heating medium for special purposes only.

Having enumerated the fuels our next step is to classify the methods for utilizing their energy as follows:

1st. General Heating.

Where the heating of the entire house or several of the rooms is from one heater, usually placed in the cellar or basement or from a distant point as in District Heating.

2nd. Individual Room Heating.

Where the heater is in the room to be heated.

These may be subdivided yet further according to the means for distributing the heat.

Central heating by:

Hot air.

Hot water.

Steam.

Individual room heating by:

Fireplaces.

Stoves or similar heaters which may be portable or stationary.

MECHANICAL FACTORS.

Certain mechanical factors have no small bearing on choice of the heater and its fuel, for instance—

Space occupied by the heater and its accessories for distributing the heat.

Materials of construction viewed not only from the standpoint of first cost but from simplicity for installation and repairs, and durability.

Operation including manual or automatic supply of fuel and manual or automatic control or regulation of temperature.

Assuming that a heater and its accessories can be properly made and installed it should not meet with our approval without assurance of *reliability* and *safety* as affected by—

Construction.

Operation.

Both of which involve, among other things, fire or other hazard.

Fuel supply, which may be affected by strikes or interference with transportation.

Thought should be given also to *character of heat* and its effect on animate and inanimate objects.

In many places the *appearance* of the heat distributor is of no small consequence but as this has usually little if any bearing on the heating result it may be left to the individual consumer for decision.

Reviewing these factors which enter into the selection of a heating system we find that all should be considered, no matter what the fuel may be, so for our purpose we may, while discussing all of them, compare the fuels *per se.*

Selection of Fuel is Governed by Cost, Convenience, Cleanliness.

Cost includes:

1st. Investment and interest thereon.

2nd. Maintenance (depreciation and repairs).

3rd. Thermal efficiency (cost per useful B. t. u.).

4th. Labor (all operating labor).

5th. Insurance.

Convenience includes:

1st. Reliability of supply (transportation, storage, safety).

2nd. Ease of handling.

3rd. Control (temperature regulation).

4th. Character of heat.

Cleanliness is affected by:

1st.—Fuel before use.

2nd. Fuel residue and products of combustion.

3rd. Control of dust laden air in the rooms heated.

Investment and interest thereon are affected by the materials used and the mechanical design of the heater and heat transmitting accessories and the complications of their installation. Cast-iron, wrought-iron or steel, copper, brass and various ceramics are the materials commonly used.

Of the metals, all are affected, but to different degree, by the products of the various fuels. Cast-iron is, perhaps, the cheapest metal to employ and its resistivity to progressive corrosion is a point in its favor. It is less affected by combustion and its products than the other metals and except in rare instances can be cast in any desired design. In point of conductivity, however, it falls behind copper, brass, wrought-iron and steel and like the latter two metals is not as effective as either copper or brass in preventing the fast adherence of incrustation resulting from the use of hard waters. Fortunately, however, troubles from incrustation in low pressure steam and hot water heating systems are mitigated by reason of the fact that the same water is used over and over again and that the temperature of the water is not high enough to cause the complete precipitation of all the salts.

Copper and brass, because of their high factor of heat transmission together with their non-corrosive properties are the most desirable but, except for small systems, are usually too expensive. Both are easily worked. They are not ex-

empt, however, from the corrosive action of sulphur and condensed aqueous vapor in the flue gases, even when the sulphur is present in only small quantities. The presence of condensed aqueous vapor is a condition more common when manufactured gas or oil is used than if coal or coke be the fuel.

Wrought-iron and steel possess greater mechanical strength than any of the other metals named, but the factor of strength is relatively unimportant in low pressure steam and hot water heating systems. Neither metal presents any manufacturing difficulties.

In connection with the subject of corrosion mention may be made of the undesirability of using a combination of two electrically dissimilar metals, such as iron and copper, because of the voltaic action which they will produce.

Refractories similar to fire clay and its products are quite unaffected by any condition of combustion prevalent in house heating appliances but are very difficult to form and bake except in small and simple shapes.

Cost of fuel storage both of space occupied and equipment should be considered also, together with additional insurance or similar charges, if any.

Maintenance will be governed by the physical qualities just mentioned, and the burning out of exposed metal parts such as grate bars must be considered here. The friability of ceramic refractories limits their use to those parts which will not be readily destroyed by the ordinary operations of use and because the use of firing tools is unnecesary with gas, oil or electricity, these materials may be used to a much larger extent than with solid fuels.

Thermal efficiency of the appliance itself is about the same, whatever the fuel, if the combustibles be completely consumed, the excess air supply the same, and ashes and clinkers are not allowed to collect on the grates or dust deposit in the flues. This excludes the higher flue temperature necessary with the coal appliance in order to produce the required draft to overcome the resistance of the coal bed. The absence of this requirement with gas or oil together with the absence of ash,

give these fuels a decided advantage. Proper control of the air supply is exceedingly difficult with solid fuel because of the variation of the rate at which the fuel is supplied, except when automatic stoking devices are employed. Such methods of stoking have not been adopted generally for house heaters.

When hot water or steam are used the pipes and passages should be kept free from sediment and with electrical apparatus the heating elements should be of non-corrodible metal.

Labor may be divided into that needed for general supervision of the appliance and control of temperature, and that for fuel and residue handling. The first requires but little physical exertion particularly if one of the many automatic controls now on the market be used. These are quite similar no matter what the fuel, but those for use with gas, electricity or district heating are somewhat more simple than those for liquid or solid fuel. Generally speaking, the labor required for the operation of either gas or electrical heaters is so little as to warrant hardly any mention. Some labor is needed for handling oil fuel and considerable is necessary for handling either coal or coke. Such labor is of a very unpleasant and objectionable character and on this account, and because of the physical exertion it requires, special employees are often engaged to perform it at some actual expense.

Insurance rates are usually unaffected by the character of fuel except in the case of oil when without appliances approved by fire insurance underwriters or special precautions for storage or use, an additional charge is often applied.

Reliability is determined not only by the action of the appliance itself but by the supply of fuel both to the heater and to the premises and here the advantage of gas is particularly patent. The heat from any appliance, regardless of the fuel, will probably be constant if the fuel supply is maintained, and in the case of solid fuel, the fire is kept clean and the air supply constant. With solid fuel, however, there is always the chance that neglect, a change of draft, or variations in other controlling factors, may upset constant conditions by causing

either too rapid or too slow combustion. This is especially so when the solid fuel heater is operated without thermostatic or similar control. Change of draft will affect combustion in a gas burning appliance, it is true, but to a much less degree.

With solid or liquid fuel a supply must be maintained of such quantity as will provide for emergency in case of interruption to transportation. Gas, on the other hand, is only delivered as used, eliminating storage on the premises and the record covering the entire world for the past century proves that the probability of failure by the distributing company to maintain a constant supply is negligible. Electricity when distributed by overhead wires is subject to serious interruption of service, but with modern generating stations and underground wires the supply may be said to be continuous.

Safety.—From solid fuels sparks are always possible and with electricity care must be taken in wiring and fusing to prevent sparking or arcing and there is always a chance of unforeseen accident from these causes. Gas or oil containers should be tight, but if a leak occurs the odor will generally be detected in time to prevent serious trouble.

In gas operated appliances it is essential that the construction and arrangement of the pilot be such that there will be no danger of the pilot being extinguished under any conditions, and of no less importance that the burners be so related to one another and to the pilot, that ignition will be effected promptly and positively.

Ease of handling has been referred to under *Labor,* and when special service is provided for this purpose it need not be considered here. When this special service is not provided the relative ease of handling is of considerable consequence not only from the standpoint of physical exertion but time required and cleanliness (to be discussed further on). Here gas oil, electricity or district heating have very obvious advantages as the regulation of supply entails practically no labor, the time required is but a small portion of that for firing solid fuel and neither effort nor time need be expended on cleaning the fire.

Control.—Proper control of temperature makes greatly for the comfort of the occupants of the house. Thermostatic devices for maintaining a uniform temperature are available at some additional expense and are practical for gas, oil and electricity but for solid fuel only if the fire is kept in proper order. Automatic hand controls conveniently operated from the living quarters are also on the market and simplify changing the temperature. When gas, oil or electricity is used the effect of change of regulation is almost immediate whereas with solid fuel some time elapses before the change is evident throughout the house.

Character of Heat.—Comfort of the occupants of a room is dependent to as great an extent on the kind and application of the heat as on the quantity alone, for if the humidity or dryness be excessive, or the circulation of air so rapid as to produce perceptible draughts, discomfort will be caused. As the capacity of air for moisture increases with its temperature heating principally by convection may be unpleasant, or on the other hand, if the heater be so small that in order to supply the required total heat a small quantity of very hot air is provided, this air may carry less than the normal quantity of moisture. If the heat is supplied principally by radiant means the units should be placed so as to give uniform heat distribution. Consideration should be given also to the circulation of air in order to provide adequate ventilation. These conditions will be met by proper design and installation of appliances regardless of the kind of fuel, but gas and electricity simplify the construction and use of radiant heaters.

Cleanliness of Fuel Before Use.—Bituminous coal is obviously an exceedingly dirty commodity to be stored in a house. Coke and anthracite coal when carefully screened are quite clean when first put in, but both are somewhat friable and after some handling dust cannot be prevented. Oil, so long as all containers, joints and valves are tight, is quite unobjectionable, but the slightest leak will make an almost irradicable spot. From either gas or oil there may be an objectionable odor through carelessness by operators.

Fuel Residue and Products of Combustion.—Ashes or clinkers from solid fuel and free carbon or soot from them and oil are the most annoying residues and a deposit of soot also promotes corrosion. Carbon monoxide, acetylene, formalene and hydrogen sulphide from incomplete combustion and sulphurous or other gaseous compounds from any fuel are also objectionable. Under present gaseous methods of gas purification the sulphur content is very small and as with modern gas burners perfect combustion is readily obtained gas may be considered, unqualifiedly, a "clean" fuel. Modern methods of burning oil assure freedom from soot only when care is used in operation, and, even then, a smoky flame with a resulting large quantity of soot is to be expected when the burners are first lighted or the furnace is cold. As house heaters with solid fuel are usually fired, a relatively large quantity of coal or coke is put into the furnace at one time. Sufficient air for good combustion under this condition is impossible, so large quantities of carbon monoxide and other deleterious products of incomplete combustion ensue and with a leaky firebox or flue these are at least annoying or possibly dangerous. Other residues are soot from bituminous coal and dust from ashes or clinkers with any solid fuel. Such residues are exceedingly annoying, not only from leakage from the appliance but during their temporary storage before removal from the premises.

Air circulation has no small effect on cleanliness, as dust is carried by the air currents and deposited when the velocity is lowered and unsightly accumulations are unavoidable, though with gas flames or open incandescent electric heaters in which the temperature of the heating elements is relatively high, no inconsiderable quantity of dust is consumed. Otherwise, the results are similar regardless of the fuel.

Summarizing the factors entering into the selection of fuel, using as the base for comparison manufactured gas in those cases where the uses of the fuels are fairly comparable and neglecting fuel cost, we have:

	Anthracite Coal	Bituminous Coal	Coke	Oil	District Heating	Electricity
COST						
Investment	Same	Same	Same	Worse	Better	Worse
Maintenance	Worse	Worse	Worse	Worse	Better	Same
Thermal Efficiency	Worse	Worse	Worse	Same	Better–a	Better–a
Labor	Worse	Worse	Worse	Worse	Better	Better
Insurance	Same	Same	Same	Worse-b	Better–b	Better–b
CONVENIENCE						
Reliability	Worse	Worse	Worse	Worse	Worse	Worse
Ease of handling	Worse	Worse	Worse	Worse	Better	Better
Control	Worse	Worse	Worse	Same	Same	Same
Character of heat	Same–c	Same–c	Same–c	Same–c	Same–c	Same–c
CLEANLINESS						
Fuel before use	Worse	Worse	Worse	Worse	Same	Same
Fuel residue	Worse	Worse	Worse	Same	Better	Better
Control of air	Same–d	Same–d	Same–d	Same–d	Same–d	Same–d

(a)—Except with certain gas appliances.
(b)—In certain cases specified by fire insurance underwriters.
(c and d)—Only in cases where the appliances are such as to make the fuels directly comparable.

from which we see that gas is more desirable than any other heating medium (fuel) except district heating and electricity. (Consideration of fuel costs follows further on.)

CENTRAL HEATING.

There are three distinct methods in use to-day for heating buildings from a central heating plant located on the premises, namely:

1. Hot-air.
2. Hot-water.
3. Steam.

These methods are at present applicable to any fuel except electricity. Their general principles are so well embedded in the minds of us all that it is unnecessary to relate them here. Our object is to endeavor to show the possibilities of these various systems when operating them with manufactured gas

and to draw a comparison of systems so operated using coal as an example. The fundamental working basis in making this comparison is the amount of work to be done and this work is the same whether we are using one fuel or another. It represents the amount of radiation which must be taken care of. Manifestly, this amount of heat is dependent on the construction of the building, the maximum differential temperature between the inside and the outside temperatures, and the required air renewals. It will not differ according to the fuel selected.

Having determined the total amount of heat necessary, one of the first points to present itself for consideration is the efficiency of the heating unit, that is, the percentage of the total heat in the fuel which the heating unit is capable of delivering for utilization. Assuming that the heat lost by radiation from the heating unit and its house connection is usefully employed, the unavailable heat in the coal operated apparatus will be represented by the stack losses (including loss due to incomplete combustion of carbon) and the unburned fuel loss, and in the case of the gas operated apparatus by the stack losses only (no incomplete combustion). The amount of unburned coal dropping through with the ash will depend upon the care of the operator and the efficiency of the grate. In a well designed heater operated with reasonable care this loss will average from 5 per cent. to 10 per cent.

Regarding the stack or flue loss it will be well to call attention first to the distinction between the purposes of the two stacks when operating with the two fuels. In the case of coal the fundamental object of the stack is to create a sufficient draft (negative pressure as compared to atmospheric pressure) to draw in the necessary air for combustion. In the case of gas the fundamental object of the stack is to carry off the products of combustion to the outside atmosphere and thereby prevent vitiation of the inside atmosphere. In each case the draft must also be great enough to overcome the resistances of the various passes and flues to the flow of the products. The different functions of the draft are so cor-

related that it is difficult to consider them in any degree of importance, but it is possible to compare them when employing the two different fuels in question. The various duties of the draft may be enumerated as follows:

1. To generate and maintain the velocity of the air entering the ash pit doors. (In the atmospheric gas appliance the secondary air inlets correspond to the ash pit doors of the coal appliance.)

2. To overcome the resistance of the fire bed. (In the gas appliance the air spaces between the burners correspond to the interstices between the coals of the fire bed.)

3. To overcome the resistance of the flue passages and heater passes.

These factors vary so much for different installations and even for any one installation, depending in this case upon the conditions under which the heater may be operated, that no representative set of figures for any particular kind of fuel can be given. It will suffice for our purposes, however, to generalize somewhat.

Of the above factors the second is clearly the most important in our comparison. The resistance offered to the flow of the products by the spaces between the burners is extremely small compared to the resistance offered by a solid fuel bed and hence the requisite draft for the operation of the gas heater is much lower than that for the coal heater because of this factor alone. In a coal heater probably 30 per cent. to 40 per cent. of the circulating pressure or potential draft is utilized in overcoming the resistance of the fuel bed.

The remaining factors are all dependent on the velocity of flow. In the gas heater this velocity is less than in the coal heater, since the volume of the products is less, and the resistance losses therefore will be proportionally smaller. This, of course, is based on the assumption that both coal and gas heaters are constructively alike.

Regarding the stack loss, the resistance to flow and conse-

quently the draft necessary to overcome it, would be greater in the case of the gas heater due to decreased stack diameter and higher flue gas density, but these factors are offset by the reduced velocity as already noted.

In Exhibit A, appended hereto, are given two theoretical determinations for coal and gas heaters based on certain assumptions. The starting point in these determinations is the requirement that 200,000 B. t. u. (about 800 square feet steam radiation or 1,330 square feet hot water radiation) are to be supplied hourly. Anthracite coal having a calorific value of 13,770 B. t. u. per pound is selected for the coal installation and carbureted water gas having a calorific value of 600 B. t. u. per cubic foot is selected for the gas installation. The thermal efficiency of the coal heater is taken as 55 per cent. and that of the gas heater as 75 per cent. An excess of 160 per cent. air is assumed for the combustion of the coal and only 50 per cent. for the combustion of the gas. The same radiation loss, 12 per cent., is taken in each case and an unburned fuel loss of 3 per cent is assumed for the coal heater. By difference the flue losses amount to 30 per cent. and 13 per cent. for the coal and gas heaters respectively. A further assumption in the case of the coal heater is the presence of 0.5 per cent. carbon monoxide in the flue gases. This amounts to an hourly loss of 15,400 B. t. u., or 4.2 per cent. of the total heating value of the fuel.

The calculated flue temperature amounts to 550° F. in the coal installation and 296° F. in the gas installation, these temperatures producing circulating stack pressures (potential drafts) of 0.31 and 0.215 inches of water respectively. With assumed stack heights of 40 feet, the diameter of the stack for the coal heater is calculated to be 12 inches and that for the gas heater is calculated to be 7 inches. The hourly volumes of the flue products, figuring them at the determined flue temperatures, are calculated to be 18,900 cubic feet and 5,390 cubic feet respectively, and the total hourly weight of moisture carried off by the products 9 pounds and 19 pounds respec-

tively. This moisture weight includes that present in the air and also that present in the unburned gas.

The hourly coal charge amounts to 27 pounds and the hourly gas consumption to 444 cubic feet. Figuring coal at $7.00 per ton and gas at $1.00 per thousand, the cost with coal is 8.4¢ per hour and that with gas 44.4¢. This is a ratio of 1 to 5.3. With gas at 80¢ and 60¢ per thousand the ratios are 1 to 4.2 and 1 to 3.2 respectively.

Without considering yet any change in the assumed thermal efficiency of the coal heater, which efficiency represents that obtainable when operating the coal heater under the most favorable conditions, it will be well to see what saving could be effected in the gas installation by a reduction in the temperature of the flue products. We have already seen that a strong draft is not essential for the operation of the gas heater and as the draft is a function of the flue temperature, it will be perfectly safe to reduce this temperature to a relatively low point. Gas heater installations have been successfully operated with stack temperatures of 140°, this reduction having been obtained by the use of an economizer located in the uptake. If, in our problem, the flue temperature were reduced to 140° by the use of the accessory just noted, an hourly saving of 10,599 B. t. u. could be effected, which represents 3.96 per cent. of the total energy in the fuel. At 140° we are nearing the dewpoint of the products, which, it will be noted is 118°. If the water or gas entering the economizer is less than 118° some of the moisture may be condensed, the amount so condensed depending on the incoming temperature. Supposing that 50 per cent. of the water vapor could be condensed at 140°, then about 9,060 B. t. u. would be transferred to the economizer, the greater part of this heat resulting from the recovery of the internal energy of evaporation. This would represent a saving of about 3.4 per cent.

An economizer could be usefully employed for preheating the return water in a hot water system or preheating the air in a hot air system. It would hardly be warranted in the

steam system owing to the relatively high temperature of the returned condensation. It might be economically employed in any of the three systems for heating hot water for general household purposes.

In passing, it may be noted that at 140° and with 50 per cent. of the moisture condensed the potential draft would be 0.1 inch of water. The overall thermal efficiency of the installation would become equal to about 82 per cent.

If now, the radiation loss, by the use of good lagging can be reduced to 6 per cent., and the flue loss be maintained at 6 per cent. by the use of an economizer, as just noted the saving effected by the economizer would increase to about 13 per cent. and the overall thermal efficiency to 88 per cent.

The 55 per cent. thermal efficiency assumed for the coal heater, it must be remembered, is high, and as stated above represents the efficiency obtainable when operating the heater under the most favorable conditions. The average efficiency would be more nearly 40 per cent. and as low as 25 per cent. when operating the heater at low capacity. With a 40 per cent. efficiency the hourly fuel cost of the coal heater in our problem would increase from 8.4¢ to 11.6¢, which, compared to the hourly fuel cost of the gas heater at 85 per cent. efficiency, would give the following ratios:

Gas at $1.00	1 to 3.4
Gas at .80	1 to 2.7
Gas at .60	1 to 2.0

With the coal heater operating at one-half the load called for in the problem and at an efficiency of 25 per cent., and the gas heater likewise operating at this load but with an efficiency of 75 per cent., the fuel cost ratios would be as follows:

Gas at $1.00	1 to 2.4
Gas at .80	1 to 1.9
Gas at .60	1 to 1.4
Gas at .50	1 to 1.2

At ¼ load, with the same efficiency for the coal heater,

namely, 25 per cent., and a 65 per cent. efficiency for the gas heater, our ratios would become:

Gas at $1.00	1 to 2.8
Gas at .80	1 to 2.2
Gas at .60	1 to 1.7
Gas at .50	1 to 1.4

Attention has already been called to the fact that a smaller stack is required for a gas heater than for a coal heater of equal capacity. In this connection it will be interesting to note that only recently an architect called at the office of a gas company to get the dimensions of a stack required to take care of an hourly consumption of about 3,000 cubic feet. He was figuring on the use of gas for a heating system using a return tubular boiler. Originally, his intention was to use coal but because of certain conditions it was impossible to provide a flue of the requisite size (22 inches by 22 inches) and gas was therefore decided upon. A flue 14 inches in diameter was recommended. This, of course, is a rather unusual case but it forcibly brings to attention another interesting aspect of our problem.

In any system of heating from a central point there is some loss in service efficiency because of radiation losses from the conduits for the heating medium. This is not a total loss for the heat is given up to some part of the house and is useful therefore, but it is not given as positively to a particular room as where the source of heat is located within the room and for this reason *individual room heaters* have a decided advantage over a central heating plant. Another great advantage of such heaters is the flexibility of the system taken as a whole for one or more rooms may be heated as desired. In the case of but part of a building being heated by a central plant the plant is operated so much below its capacity as to be noticeably inefficient. Any fuel may be used for such individual heaters but the dirt and annoyance from any fuel but gas, electricity or district heating preclude their use except in but few special cases.

Reference has been made to an excess cost for house cleaning when solid fuel is used. Unfortunately no definite figures are available but it is clearly recognized in cities where natural gas generally has displaced coal that the frequency of cleaning curtains, wall paper, floor coverings, and similar furnishings, is much less than when coal is used. This is not alone from the lessened smoke or soot but also from the absence of dirt tracked into the house by those whose duties take them to the cellar where fuel and ashes are stored.

Much space in the cellar is also made available when storage of fuel or ashes is unnecessary.

While we do not wish, in this paper, to discuss the commercial side of the heating question we feel that we may be permitted to offer a suggestion for the furtherence of the gas heating business. We must recognize that it is still in its infancy and that it cannot at once attain maturity. A gradual development is the best we can expect and its steady growth may be best accomplished by the cooperation of those on whom we must depend for such growth, the consumers—A glance at the tables of comparative fuel costs in Exhibit B shows that unless gas is lower, or other fuel higher, in cost than usual that there is a differential unfavorable to gas, which may be nearly, if not entirely, offset by the advantages of gaseous fuel and the economies of operation. As these are most evident during the seasons when the heating is light or intermittent it appears obvious to us that we should endeavor to introduce gas appliances as auxiliaries to the present appliances with the recommendation that they be used only during such times in spring and fall as seem to the consumer to be justified by the operating expense and factor of convenience. We should add that they may be used as "boosters" during spells of extremely cold weather when the regular system is inadequate. Such installations have been in successful operation and experience shows that the days of use increase with each year as the many favorable features become more obvious to the consumer with the result that in many cases gas will ultimately become the

sole fuel used. As such use is optional with the consumer the probability is that he will be better satisfied than if the use is as specified by the gas company. Such a line of development will not excuse us from giving the design, installation and operation of the heaters our closest attention to avoid misuse.

In conclusion we hope that we have succeeded in showing that the use of gaseous fuel for house heating is perfectly legitimate but that a more serious effort on the part of gas companies to develop proper means for use is necessary. The National Commercial Gas Association through its Committee on Heating has suggested some experimental types of auxiliary gas house heaters and we recommend that these or similar installations be followed up, more tests made with appliances modified as experience shows best, and that a committee on house heating appliance design and installation be appointed by the Institute to coordinate the work of our members and cooperate with the similar committee of the National Commercial Gas Association for the furtherance of this work.

EXHIBIT A.

THEORETICAL DETERMINATIONS FOR COAL AND GAS CENTRAL HOUSE HEATERS.

Coal.		Gas.	
Kind:		Kind:	
Anthracite.		Carbureted water gas.	
Ultimate Analysis:		Composition:	
Carbon	85.94	Illuminants	10.7
Hydrogen	2.41	33.6% benzene—3.6	
Nitrogen	0.88	66.4% ethylene—7.1	
Oxygen	2.17	Carbon monoxide	33.4
Ash	8.08	Hydrogen	38.1
Volatile sulphur	0.52	Methane	7.6
	100.00	Ethane	2.4
Proximate Analysis:		Carbon dioxide	3.3
Moisture	2.25	Oxygen	0.7
Volatile matter	8.06	Nitrogen	3.8
Fixed carbon	81.80		100.00
Ash	7.89		
	100.00		
Calorific value dry coal	13,770	Calorific value (gross) of gas—calculated	600.3
Assumed volume of air required per pound coal	350	Theoretical volume of air necessary for complete combustion	5.12
Theoretical volume of air necessary for complete combustion	134	Per cent. excess assumed	50
Per cent. excess	160	Calculated volume of air per cubic foot of gas	7.68
Assumed outside temperature of air	32	Assumed relative humidity of gas	50
Assumed relative humidity of outside air	80	Assumed outside temperature of air	32
Assumed temperature of inside air	52	Assumed relative humidity of outside air	80
Assumed relative humidity of inside air	50	Assumed temperature of inside air	52
		Assumed relative humidity of inside air	50
Assumed thermal efficiency of coal heater	55	Assumed thermal efficiency of gas heater	75
Assumed radiation loss	12	Assumed radiation loss	12
Assumed flue loss	30	Assumed flue loss	13
Assumed unburned coal loss	3		100
	100		

Assumed total hourly heat required	200,000
Calculated hourly heat in coal	363,636
Pounds of coal per hour	27.02
Heat lost by radiation per hour	43,636
Heat lost in flue per hour	109,091
Heat lost in unburned coal	10,909

Assumed percentage of CO in flue gases	0.5
Calculated carbon dioxide	7.05
Calculated oxygen	13.39
Calculated nitrogen	79.06
	100.00

Hourly heat loss due to presence of CO	15,399

Pounds of water formed by combustion of coal per hour	5.739
Pounds of water in coal as fired per hour	0.608
Pounds of water in air supplied per hour	2.979
Total pounds of water in flue products per hour	9.326

Calculated temperature of flue products	550
Hourly volume of products at flue temperature	18,930
Weight of 1 cu. ft. air at 32°—0.8 R. H.	0.0803
Weight of 1 cu. ft. products at 550°	0.0400
Circulating stack pressure lbs. sq. ft./ft.	0.0403
Assumed stack height (ft.)	40
Circulating stack pressure in inches of water	0.31
Calculated stack dimensions if square	11 in. x 11 in.
if round	12 in. diam.
Dew-point of products	64

Assumed total hourly heat required	200,000
Calculated hourly heat in gas	266,667
Cubic feet of gas per hour	444.3
Heat Lost by radiation per hour	32,000
Heat lost in flue per hour	34,667

Calculated carbon dioxide	11.3
Calculated oxygen	7.2
Calculated nitrogen	81.5
	100.00

Pounds of water formed by combustion of gas per hour	17.912
Pounds of water in gas as burned per hour	0.139
Pounds of water in air supplied per hour	1.064
Total pounds of water in flue products per hour	19.12

Calculated temperature of flue products	296
Hourly volume of products at flue temperature	5,390
Weight of 1 cu. ft. air at 32°—0.8 R. H.	0.0803
Weight of 1 cu. ft. products at 296°	0.0524
Circulating stack pressure lbs. sq. ft./ft.	0.0279
Assumed stack height (ft.)	40
Circulating stack pressure in inches of water	0.215
Calculated stack dimensions if square	7 in. x 7 in.
if round	7 in. diam.
Dew-point of flue products	118

EXHIBT B.

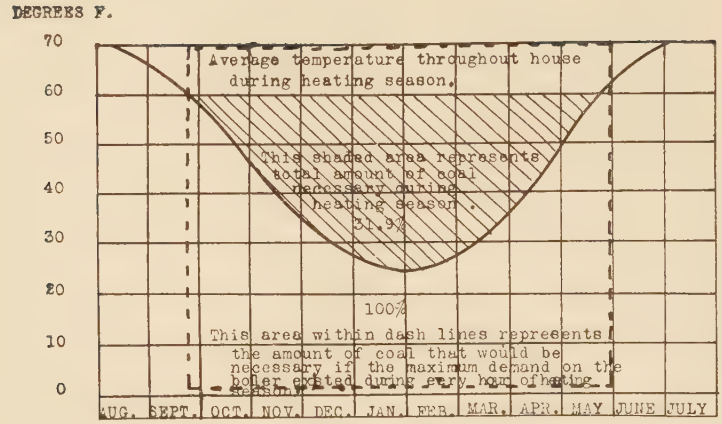
RELATIVE COSTS OF HEAT ENERGY AS SUPPLIED BY VARIOUS FUELS AND DISTRICT HEATING SYSTEMS.

Fuel or heating system	Calorific value B. t. u.	Fuel cost	Thermal eff. per cent.	Cost per 1,000,000 Useful B.t.u. Cents	Relative cost Gas = 100 Thermal efficiency											
					100 per cent.				80 per cent. Cost per M				60 per cent.			
					$1.00	.80	.60	.50	$1.00	.80	.60	.50	$1.00	.80	.60	.50
Gas Mixed Coal and Water	600 B. t. u. per cu. ft.	per M. $1.00	100	167												
		.80	100	133												
		.60	100	100												
		.50	100	83												
		1.00	80	208												
		.80	80	167												
		.60	80	125												
		.50	80	104												
		1.00	60	277												
		.80	60	222												
		.60	60	167												
		.50	60	139												
Anthracite Coal	14,000 per lb.	$7.00 per ton	100	22.3	13	17	22	27	11	13	18	21	8	10	13	16
			60	37.2	22	28	37	45	18	22	30	36	13	17	22	27
			40	55.7	33	42	56	67	27	33	45	54	20	25	33	40
			25	89.3	53	67	89	107	43	53	71	86	32	40	53	64

EXHIBIT B.—(*Continued*).

Fuel or heating system	Calorific value B. t. u.	Fuel Cost	Thermal eff. per cent.	Cost of 1,000,000 useful B.t.u. Cents	Relative cost Gas = 100 Thermal efficiency											
					100 per cent.				80 per cent. Cost per M				60 per cent.			
					$1.00	.80	.60	.50	$1.00	.80	.60	.50	$1.00	.80	.60	.50
Bituminous	14,000 per lb.	$4.50 per ton	100	14.3	8.5	11	14	17	7	8.5	11.5	14	5	6.5	8.5	10
			60	23.8	14	18	24	29	11.5	14	19	23	8.5	11	14	17
			40	35.8	21	27	36	43	17	21	29	34	13	16	21	26
			25	57.4	34	43	57	69	28	34	46	55	21	26	34	41
Coke	14,000 per lb.	$7.50 per ton	100	23.8	14	18	24	29	11.5	14	19	23	8.5	11	14	17
			60	39.8	24	30	40	48	19	24	32	38	14	18	24	29
			40	59.7	36	45	60	72	29	36	48	57	22	27	36	43
			25	95.6	57	72	96	112	46	57	76	92	35	43	57	69
Fuel Oil	17,800 per lb. 117,500 per gallon	$0.06 per gallon	100	51	30.5	38	51	61.5	24.5	30.5	41	49	18.5	23	30.5	37
			80	64	38	48	64	77	31	38	51	61.5	23	29	38	46
			60	85	51	64	85	102	41	51	68	82	31	38	51	61
District Heating— Steam and Hot Water		20,000 B. t. u. $0.01		50	30	38	50	60	24	30	40	48	18	23	30	36
Electricity	1 Kw. hr. 3,412 B. t. u.	$0.10 per Kw. hr.	100	2930	1750	2200	2930	3530	1405	1750	2340	2820	1060	1320	1750	2100
		.08	100	2340	1400	1760	2340	2820	1120	1400	1870	2250	845	1050	1400	1680
		.06	100	1760	1050	1320	1760	2120	847	1050	1410	1690	635	794	1050	1270
		.04	100	1170	701	880	1170	1410	562	701	936	1120	423	527	701	842
		.02	100	586	350	440	586	706	282	350	468	563	212	264	350	421

EXHIBIT C.



The curve illustrates a point that has been brought out in the paper, that is, the field for use of gas during the intemittent heating season.

The curve is a thirty-nine years monthly mean temperature curve at Buffalo, N. Y., and shows that fuel at the rate of a little over 30 per cent. of the maximum rate is required. The amount needed up to the 1st of December and the amount needed after the 1st of April being a very small part of the total. During these months a coal fire would be operated very inefficiently while a gas fire would be operated at as high an efficiency as if it was being operated at its maximum.

Mr. Geo. S. Barrows (Providence, R. I.): Mr. Chairman and gentlemen, this paper is really an engineering discussion of the principles involved. It is rather a difficult paper to read on account of the figures and tables, and I am only going to point out the salient features of it.

First, I want to read the introduction:

(After reading the introduction, the speaker said:)

That is a point that I think we may be more or less to blame for; we have not blown our own horn quite enough about the gas heating.

On page 910 we discuss the different kinds of fuel, or sources of heat, because in any consideration of the use of gas for house heating we must consider it only on a competitive basis. The consumer is interested in the result he gets and what it costs him.

We consider manufactured gas. We omit natural gas, because natural gas and manufactured gas are very slightly competitive.

We take up anthracite coal, bituminous coal, coke, oil, wood, district heating—that is, district heating from a central station —and electricity.

We go on and discuss the mechanical factors that affect the construction of the appliances, give consideration to the material of construction and the character of operation.

We then discuss the selection of fuel, and point out the different characteristics of the fuel, the cost, the convenience, the cleanliness—they are all subdivided.

On page 914 we give a consideration of the thermal efficiency of the appliance. We say that the thermal efficiency of an appliance is about the same whatever the fuel if the combustibles be completely consumed.

We consider the labor charges, which of course have considerable bearing on the ultimate cost to the consumer.

The question of insurance probably has a bearing only in certain instances.

Reliability is a point on which we place considerable emphasis.

We discuss safety, ease of handling of fuel, control—that means the temperature control—which is perfectly possible with any kind of fuel; the character of the heat—which is practically the same no matter what the kind of fuel; the cleanliness of the fuel before use, and the fuel residue in the process of combustion.

Our circulation is practically the same in all cases.

And then we come to the table on page 919 in which we try to make some comparison of the advantages and disadvantages of the various fuels. We find that when we consider

the item of investment in comparing the different fuels with gas, that the investment cost for the installation is practically the same, whether anthracite coal, bituminous coal, or coke is used. When oil is used the cost of installation with gas is probably more than where oil is used—that is, the cost of gas is less than the cost of oil. Where district heating is employed, the cost of installation is less because there is no heating appliance to put in. Where electricity is used the cost of the electrical appliance is more than the cost of gas.

Maintenance: The gas has an advantage over every form of heat except district heating. Of course, with district heating the only maintenance is the up-keep of the radiators.

In thermal efficiency the gas has an advantage over any of the solid fuels. It is about the same as oil, but is probably less—it must be less than where district heating is used if we only consider the heat which is delivered to the consumer's premises; that is, if we do not consider the heat losses during the transmission from the central station to the house. Of course, where electricity is used we have practically 100 per cent. efficiency, so that gas is less even than electricity.

Labor: Gas is cheaper than anything except the central station and electricity.

Convenience: So far as reliability goes we think that gas is better than anything else; that is, all of these others are worse off than gas. Where we have solid fuels, the reliability, which includes the delivery of the fuel, the storage on the premises, and the handling, it is obvious that gas is better. With oil there are certain difficulties where the oil is stored on the premises, and with steam heating there is a possibility of a failure in the mains, and with electricity, of course, there is always the possibility of a failure in the distributing system.

Ease of Handling: Gas is better than any of the fuels except central station heating and electricity.

Control: It is better than the solid fuels. About the same as the others.

Character of Heat: It is practically the same, except in

cases where the appliances are such as to make a fair comparison impossible. That is, it is only when the appliances which are used for heating are all of the "radiant heat" type, or where they are all of the "convected heat" type. Where the appliances give the same kind of heat, then the fuels are directly comparable.

Cleanliness: Gas has no advantage over electricity.

Fuel Residue: There is practically no residue from either the gas or oil, and of course, none from the central station or electricity.

Summing up the table, it shows that gas has distinct advantages over all fuels except district heating and electricity.

On page 920 is a point I think we ought to emphasize rather more than we have done in the past. We do not have a smokestack. We have a ventilator for all gas appliances. And if we realize that it is a ventilator and consider it a ventilator we can get away from some of the restrictions that have been placed on ventilator or stack construction by some of the insurance companies who have apparently considered that a stack for gas appliances should be as thoroughly insulated as the stack for solid fuel appliances.

We then pass to theoretical consideration of the determinations of the efficiency of the different appliances which are shown in the exhibits. And summing up the table, a summary which you find printed in the paper, if we assume—and this is done particularly by some of the questions that have been asked of me in the last day or so—if we assume 12,000 B. t. u. per pound of coal—we have assumed in the tables 14,000 B. t. u. per pound of coal—that has been rather questioned, and I am assuming now we have only 12,000 B. t. u. available in hard coal, at a cost of $8.00 per ton. We have assumed a price of $7.00 per ton for hard coal, but $8.00 seems to be a fairer figure to use. And in the tables we have used a long ton of 2,240 pounds. Now, I am changing that to a ton of 2,000 pounds. If we assume coal at 12,000 B. t. u. per ton of 2,000 pounds, and $8.00 a ton, and 50 per cent. efficiency for the coal appliance, we find that we can get 1,000,000 B. t. u.

for 66 cents. If we take gas at 550 B. t. u. instead of the 600 assumed in the tables, and take an efficiency of 75 per cent., we find the 2,400 cubic feet of gas are the equivalent of the coal. That is, gas could be sold at 27 cents per 1,000 feet to compete on a thermal value with hard coal at $8.00 a ton.

I do not feel that the gas companies have been to blame in any way for not getting more heating business. We have been proceeding along the lines of least resistance. The gas companies have all been after the dividends to the stockholders. If we could get better returns by selling gas for lighting, it is only fair we should have gone after the lighting business. If now we can get more returns by the development of the industrial field we should go after it. As soon as the time comes when it seems to us that we can get more returns by getting house heating, we should go after that also. It seems to me as though the time is ripe to go after this house heating. In certain towns and communities where the house load has been desirable the gas companies have done that and have been able to get it.

One great need that we have for a furtherance of house heating is the clearing house that was mentioned by Mr. Russell, I think, when speaking of industrial fuel appliances. And that is referred to in the paper.

The National Commercial Gas Association has had a committee on house heating for 2 years. The first year they collected what information they could from different gas companies, the idea being to get specific cases of gas house heating that they could use in quoting to other consumers, or to prospective consumers. The next year they went a little further with that work. This year they have made a considerable step in advance of what they have done before. They have secured photographs of houses of different forms of construction in different sections of the country. With those illustrations of the houses they show the approximate cubical contents of that house. They give the gas bills in those houses for a number of years. And from that information it is possible for a canvasser to quote to a prospective consumer such

figures as will enable that consumer to use his own judgment as to whether or not he wants to use gas in his house. The canvasser can go to the consumer and say, "Here is a house, which is essentially like your own in construction and in size, and it is in approximately the same latitude, and probably the climatic conditions are about the same. It cost this particular consumer, as you can see from these bills, so much for heating his house last year." And this man can use his own judgment as to whether he is willing to attempt the cost of heating.

The National Commercial Gas Association is doing that work. I presume that the work of that committee will be continued next year so that they will have a very much larger number of cases, so that they will have a fairer average. I would like to suggest that the American Gas Institute appoint a committee on gas heating appliances and designs in co-operation with the National Commercial Gas Association. They need somebody else to help them out. If we will appoint a committee to carefully consider the design of appliances, the methods of installation, and co-operate with that committee we are going to get along very much further with the development of gas for house heating. And until we do that I am very much afraid that we are not going to make the progress that should be made.

We cannot lay down any hard and fast rules. We cannot say that gas is going to cost so much. We have to consider the temperature to be delivered. We will have to be careful about that in quoting figures, some people are satisfied with an average house temperature of 65°, others may want a temperature of 80°, all such factors as that will have to be considered in quoting figures to prospective consumers.

THE CHAIRMAN: Gentlemen, while Mr. Alfred Forstall is preparing to throw a firebrand in the ranks on this subject of house heating, I am going to ask the Secretary to read a notice.

THE SECRETARY: An exhibit by the Gas Industry Manufacturers' Association, of experiments and various devices

used in the manufacture of gas, which is of interest to the members, is being held in the Florentine Room. You are invited to attend.

Mr. A. E. Forstall: I am not prepared to throw any firebrands in this particular matter. I have never contested the fact that house heating could be done by gas, although I think a good many people have the idea that I have taken that ground. The only ground that I have taken has been that the house heating by gas as a business through the entire winter was not a business for which a gas company could give a special rate. And it is not.

Now, in reference to this particular paper, I happen to be one of the not very many people in the country who was the *corpus delicti* in an experiment on house heating by manufactured gas. It was a good many years ago, and we did not know the calorific value of our gas in those days, nor did we measure the efficiency of apparatus quite as closely, but I was interested in checking up the actual results of two years' operation of that particular appliance as against the theoretical figures that Mr. Barrows has given in his paper. In that experiment, coal at $5.00 per gross ton, as compared to gas at $1.00 a thousand, showed a ratio of expense of one to 4.4; that is, the gas at $1.00 a thousand cost 4.4 times as much as the coal at $5.00 per gross ton. It is probable that the gas that was being used had a calorific value of not less than 660 B. t. u. With coal at $7.00 a ton and 600 B. t. u. gas the rates would have been one to 3.45; which comes well within the range of Mr. Barrows figures.

That experience convinced me that one point made in the paper is a very good one. There is no question that even with no allowance for additional comfort a house can be heated more cheaply by gas than by coal during the early fall and the late spring, even with gas at $1.00 a thousand. There is also no question that when heating a house by gas during those periods of the year you get a great deal more comfort than when coal is used.

There were a great many days in which the house would

have been very uncomfortable if there had not been any heat, and on which the furnace burned possibly only an hour to an hour and a half, but not continuously. That heat in the morning was necessary to make the house comfortable for the rest of the day. If it had been obtained with a coal appliance the house would have been uncomfortable during a large part of the day. So no gas company need fear, or need worry about going out to get house heating business on an auxiliary basis. There is no question that there is plenty of it to be had, that it is good business, and that no reduction in price need be made to get it.

Mr. Barrows: Mr. Chairman, may I ask Mr. Forstall briefly to describe the character of the appliance that was used, just to give an idea of what it was in this particular case of appliance.

Mr. Forstall: It was a hot air furnace made especially to be heated by gas, which was simply slipped into the place of the hot air furnace heated by coal. There was one large burner in the base of furnace, which either burned full on or was out. A pilot flame was kept burning, using gas enough to be certain that it would not go out. I tried at the start to run without a thermostat, but I soon found that I was overheating the house and wasting gas. So after a week a thermostat was put in and from that time on the regulation of temperature was perfect. I do not think the house varied more than 2° all through the winter. And covering your point we were working for 70°.

Mr. Barrows: Just a minute, Mr. Forstall: That was simply the burner without any radiant from the burner?

Mr. Forstall: No radiant.

Mr. Barrows: All the product of combustion passed through the furnace as heated convection, and probably your stack temperature was very high?

Mr. Forstall: The stack temperature was not high. You could put your hand on the outlet of the stack pipe, or flue

pipe within a foot of the furnace and press it hard without burning you.

Mr. Barrows: What I wanted to get at, you did have an efficient appliance then?

Mr. Forstall: I think we did, yes.

The Chairman: Mr. Forstall, before you sit down, what was the consumption per hour of this furnace?

Mr Forstall: The rate of consumption per hour was, as I remember it, about 150 to 170 cubic feet.

At night we turned the thermostat down so that the temperature probably dropped to 50 or 55° in part of the house.

The Chairman: Is Mr. Howell in the room? (No response.)

Is Mr. Metzendorf in the room? (No response.)

These gentlemen are connected with the Board of Thermal Research of the American Radiator Company, and we would have liked to have heard from them if they were here.

Mr. Barrows: Mr. Chairman, I would like to say it is possible neither Mr. Howell or Mr. Metzendorf have been able to get here. They will contribute a written discussion. The Institute of Thermal Research of the American Radiator Company at Buffalo is very much interested in this subject, and if we can establish our clearing house or get our committee appointed on the design of house heating appliances, I know that we will be sure of their co-operation.

Mr. G. I. Vincent (Des Moines, Iowa): For some years I have had this auxiliary heating idea in my head. I happen to live in a climate that is subject to very wide and sudden variations in temperature. And it seemed to me that if we could have an efficient and satisfactory auxiliary heating appliance installed in the house, in addition to the regular heating equipment, that it would have a large utility. I picked out the best one I could find on the market, and installed it about a year ago. And I do not see how we ever got along without it. The appliance leaves much to be desired mechanically, but it is very efficient, over 90 per cent. It is in

practically constant use in the spring and fall, and occasionally in the summer. For instance, in August, which in Des Moines generally is indescribably hot, it was in use one full day, and parts of two days; and on one of these days we certainly would have had to start the furnace, if the gas heater had not been there ready for use.

The point of the matter is that there would undoubtedly be an extended use of this kind of an appliance, even in as severe a climate as Iowa. The difficulty is that there is no appliance on the market that is mechanically satisfactory. This one is all right in my own home, but I would hesitate to install it for our general consumers.

All that brings us right back to Mr. Barrows' suggestion, that if a committee could be appointed on designing appliances of this kind that would be satisfactory, it certainly would go a long way toward solving this problem.

Mr. Barrows: Did Mr. Vincent say whether it is a hot air furnace, or hot water, or steam?

Mr. Vincent: That was a miniature hot air furnace installed in the floor.

Mr. B. B. Brown: I would like to ask whether any experience has been had by any of the other men experimenting along this line of auxiliary house heating with the new types of so-called radiant fireplace heaters? For a great many years, particularly in the more severe climates—Milwaukee, perhaps, compares on about the same lines with Des Moines, we have that very severe drop that Mr. Vincent speaks of coming very frequently. For a good many years the houses were built with fireplaces fitted with gas logs and various types of the unspeakable asbestos fronts and other obnoxious odor arrangements that discredited gas pretty thoroughly. And of course those fireplaces still exist. Recently a great many of the better class houses have been built with very much more practical fireplaces that have been designed for the use of heavy fuel of various kinds. Now, we find that almost invariably those people would like to be acquainted with something that is more efficient and more practicable, and more de-

sirable than any of these devices that have been used in the past as fireplace heaters. And we have been doing some experimenting with a type of so-called "radiant" heater which was developed in England. And we found it so marvelously efficient and so entirely satisfactory that we think there is a big future for it. There will be, perhaps, several manufacturers in this country working on that thing now. While the English type is no longer to be had during the stress of war-time conditions, we are so well pleased with it as an auxiliary heating proposition that we think every one else ought to be interested and ought to know about it.

They called it a radiant heater, and the manufacturers extolled its merits and talked about the difference between heating rooms by convection and by radiation, and we did not think very much of it. But when we first put one of those heaters in use in some of our own houses we were very much surprised at the almost immediate effect in the middle of a good sized room from this radiated heat. It is simply combustion at higher temperatures than you can get on any of the old time fireplace devices. I think any of you that have not seen it will find, as we did, it is something that is very useful. It requires no additional investment on the householder's part, and it fills in that little chink that Mr. Vincent speaks of.

It is a very desirable business. Most of it does not come on your peak, and it is business that people once come to depend on, they will use it, and it is business that satisfies and pleases the consumer, and that is the kind of business that we want to get.

Mr. Myers: With regard to this matter of radiant heat house heating about which Mr. Brown has just spoken, I can but refer you to a section of the report of the utilization of gas fuel appliances which will be submitted to this meeting. In that report you will find a section and an exhibit devoted to the subject of radiant heat from blue, luminous flame heaters. That exhibit shows a table in which is given the radiant efficiencies of various room heating devices, among them being several of foreign design, of the type of which Mr. Brown

has mentioned. Those efficiencies run up as high for the front as 67 per cent. That experiment was performed on an appliance almost exactly like the one Mr. Brown has described.

The fireplace competition which took place several years ago, I believe first brought this subject of radiant fireplace heaters to the attention of the gas industry in this country. And I am very glad to say that at the present time there is on the market an English type fire made in this country. The elements are practically the same as the elements in the English heaters, but the burner itself has been simplified and is very efficient, so that the gas industry has now in this country available an American-made English type fire which as far as we can tell is very efficient and very good.

Mr. G. W. Clabaugh: Mr. Chairman, we are very much interested now in auxiliary hot water appliances, by using an automatic heater and running a ¼-inch pipe to the radiators, and for auxiliary heating using this automatic arrangement. As far as we have gone it has been extremely satisfactory. Still I cannot give you any figures because we have not experimented long enough. But we believe that there is something in it.

In the talk this morning, all of the comparisons have been made practically with coal—that is, a between-seasons fuel. We have a competitor in oil in Omaha. And you have in this fuel all of the advantages in turning down, or out, if you please, that you have with gas. It is a big factor with us. I have an oil furnace. I use the oil in my hot-air furnace in my house, and it is very satisfactory. Where it is used in the steam furnace or the hot-air or hot-water—I think more particularly with hot water, it is more satisfactory and a little bit cheaper. It can be used and is going to be a very great competitor of the gas heating between seasons if pushed all over the country as it is in Omaha.

I just bring this to your attention because it may not have been started in some of your cities. And I know that it works satisfactorily.

Mr. D. A. Reed (Duluth, Minn.): Duluth is probably as far north as any of the cities represented here. And perhaps our method of house heating might be interesting as a matter of news.

As you know, there is about 6 months winter, and about 2 months spring, and about 2 months autumn—and the rest they call summer. We have found a great deal of success by the use of the copper coil heater—the three-coil heater such as might be represented by the No. 80 Rex. We have used a great many of those in our installations, and have connected them up with a cast-iron hot water boiler that is used with the coal installation. Many of the installations in Duluth for house heating consists of a coal boiler, circular cast iron sections. We connect the Rex heater, 1-inch inlet and 1-inch outlet, the inlet near the bottom connections of the boiler, and the outlet of the Rex connecting with the 2½- or 3-inch pipe leading from the top of the boiler to the radiator. It is necessary during the mild weather to get up a little early in the morning and light this heater. After it runs for a few hours it is turned off. If it is a particularly cold day, it is allowed to burn all day, or it can run all night, or continuously.

In my own house I have one Rex heater. In some of the other houses there are two Rex heaters, one connected on each side of the boiler.

The bills run from $2.00 a month to $8.00 a month generally, for these installations. The price of the heating gas is 50 cents a thousand, and the price of anthracite coal is from $8.50 to $9.00 a ton. We have some forty to fifty of these installations which have been in service about a year and a half, and they are increasing quite rapidly.

In the coldest part of the winter, in January, February and March, we do not sell much heating gas. They are practically shut off, although they are used to some extent in cold weather to supplement coal. Both can be operated at the same time, or either one separately.

The Chairman: We have had some little experience with

house heating in St. Louis, most of it on a little larger scale than has been mentioned this morning.

For instance, we have twenty-eight consumers who averaged 761,000 cubic feet each for the 5 or 6 months heating season. I presume we have probably one hundred and fifty consumers all told. There is no special rate for house heating in St. Louis. Gas is sold for house heating purposes at exactly the same rate as for any other kind of business.

We thoroughly appreciate the disadvantages as well as the advantages of house heating when considered from a gas company's standpoint. The disadvantages are as follows:

1. The consumption takes place in one period of the year only, and that period is not entirely off of peak load.

2. Should a number of very cold days occur in succession the demand on the works would be abnormal.

3. When sudden changes of temperature occur the gas lighting appliances will probably be lighted at about the same time, so that the diversity factor on the distribution system is small.

The advantages might be stated as follows:

1. Increased sales.

2. The average consumption of the consumer who uses gas for house-heating purposes will be very large.

3. Educational. Consumers grow accustomed to using and seeing gas used in large quantities.

And it does have this pleasant effect that Mr. Brown speaks of with the consumer. For instance, I went to one consumer and asked how they were getting along. What they thought of gas heating? The lady of the house told me it was "uncanny." I thought that this was a new complaint I was up against. I asked her what she meant. "Well," she says, "all that I have to do is to go to this little button on the wall and move it up or down in order to change the temperature of my entire house 2° or 4° or whatever I want, and at night I can set this little clock and automatically my house cools off at night and again automatically heats up to the proper temperature in the morn-

ing. It is so human that it is really uncanny." That is the way she put it.

The effect on the distribution system of a house-heating plant consuming 500,000 cubic feet per year is no greater than that produced by an instantaneous water heater. In fact a water heater produces fluctuations in pressure at frequent intervals, whereas in an automatically controlled gas heating plant the pressure remains practically the same as long as the burners are lighted, which is usually for a considerable period of time.

Our experience shows that the sales of gas for house heating for the year is almost exactly one hundred times the amount used for this purpose on the maximum day; but the maximum day for house heating does not coincide with the maximum day for other uses. The maximum day for house heating usually occurs in January and February.

The ability of a gas works to take care of very largely increased loads is well illustrated by the large increases in consumption which are being experienced by many companies, due to the increased consumption of gas by large manufacturers of munitions at the present time. Many of these companies are experiencing enormous increases in their daily peak load, yet they are in some way or other managing to take care of these increased loads successfully. While it is true that much of this increased business may be permanent, it is equally true that a great deal of it will be lost as soon as the demand for munitions is passed.

It must also be remembered that gas used for auxiliary house heating has exactly the same effect as gas used for house heating exclusively. The increased load comes in the month of October, at which time many plants experience their maximum day's output.

We are not committed to any policy on house heating. We know from our experience that it will not reach such figures as to get away from our control. The heating of the house throughout the entire season with artificial gas will probably be too expensive to result in any exceedingly large peak loads,

for instance, such as you have in natural gas communities. We are getting a lot of information, we are educating the people to understand the value of gas and to know what a really safe product it is, even when used in very large quantities. It assists in doing away with the smoke nuisance, and that gives us the co-operation of a large number of people.

All of our large plants are automatically controlled by means of thermostats, and are all regularly inspected. We watch them very carefully. We are accumulating a very large amount of data. We have taken daily readings, for instance, in a large number of plants for an entire heating season, and in this way we have found much valuable information relating to peak loads. We are finding out just how much gas it takes to heat a house during the various months of the year, and this information should be of great value in making comparisons of the cost of gas with the cost of coal and other fuels, when gas is used for auxiliary purposes.

We feel that every field for the use of gas should be carefully investigated before it is judged, and we should all cooperate in developing this field until we have such information as will enable us to determine just what policy it will be best for any gas company to follow.

Mr. Geo. H. Waring: Mr. Chairman, there is a small section of the country south of the Ohio and Potomac and east of the Rocky Mountains that I wish to refer to in regard to house heating.

All the remarks have been in connection with auxiliary house heating. In Charleston, South Carolina, we estimate that we have 50 per cent. of the entire residence and office heating for the whole season. We know we have practically all the churches and halls. This heating is not, as I say, auxiliary, but for the entire season. Now, there is no reason why all places in that section of the country which I described should not endeavor to get heating for the entire season. And in the northern climate where you have relative months of the temperature that we have for our winter, you can get the entire heating for that portion of the season. For instance, our

temperature ranges normally from freezing to 75°. When the temperature in Charleston is 75° in the winter we have a certain send-out. That send-out we estimate is entirely for other purposes than heating. When the temperature is freezing, our send-out exactly doubles. It is almost a positive condition. If on a day of 75° the forecast is for freezing weather the next day, we know that we are going to send out twice as much gas as we did on the previous day. We feel sure, therefore, that we have a pretty good line on just what that business means to us.

We believe that can be done in all sections where the temperature range for the same season is similar.

For instance, with weather of this kind there is no reason why Chicago should not heat in October with gas. The temperature to my mind to-day would be uncomfortable in the average residence with a furnace.

We have been faced with the proposition of greater investment to take care of this peak. And we find that this is not a large problem. We know of a city in the south that is rather discouraging house heating for the reason they do not think it is profitable on account of the enormous peak that they are afraid they will build up. We have not taken this view, and I do not believe that that is going to be an unsurmountable difficulty for the city that is rather discouraging continuous gas heating.

We feel this is a matter that should not be discouraged by Mr. Forstall's "firebrand," and I think that ever since this matter was brought up by Mr. Rice in a meeting of years ago as to what he was doing in Norfolk in regard to this house heating and church heating, that certainly as far north as Norfolk we can heat successfully with gas all winter.

The Chairman: I would like to ask if it is not a fact that a number of companies have their peak loads for several days over-lap in the month of October. And if that is so will not auxiliary heating have just as much effect on that load as though it came at a later date? I simply want to bring out the point.

Mr. R. B. Brown: I think I can possibly partly answer that, Mr. Chairman.

Our experience has been in the installations we have kept very close tab on, that the larger proportion of gas is burned in the morning. There is a portion of it comes on the peak, there is no getting away from that, but there is not enough of it additional, and the largest portion of it is burned in the morning hours that are entirely off our maximum peak.

The Chairman: Mr. Brown, are you speaking of the distribution or the manufacturing peak?

Mr. Brown: The distribution peak. We do not have any manufacturing peak.

The Chairman: I want to make that clear, because that is the gist of the whole question. A week or ten days of exceedingly cold weather in the month of January is the one thing we fear in house heating. Distribution loads cut much less figure than those on the plant?

Mr. Brown: Yes. I thought you were talking about the distribution peak, because it is the distribution peak if anything that would bother us in such months as October.

This question of the fear of house heating from either distribution or manufacturing peak standpoint, it seems to me very largely hinges upon the question of rate.

I agree with Mr. von Maur that we have no fear on that subject at all as long as we maintain the same rate for this purpose that we do for all other purposes. But I do not mean by that that the heating will not take a lower average rate with most of the companies that have step rates or any other form of rates which conform somewhat closely to the cost line, and therefore has the effect of making a lower rate to the large consumer. And I do not believe that a special rate for heating is a good thing. Of course that is a dangerous proposition.

As to actual data, I would like to speak of an installation which we have just made in Milwaukee, and on which we expect to have recording thermometer readings of the out-

side temperature, the atmospheric temperature, and the temperature of the house, and record the meter readings of the gas used for every moment in the 24 hours throughout the entire season. We expect to make daily, weekly and monthly plottings from these recording temperature and gas consumption records. We expect to find that we will be able to establish relative conditions there that will be very valuable as engineering data.

We have been much surprised to find that the figures that Mr. Forstall had—and by the way I had the pleasure of living in the same apartment that Mr. Forstall lived in and ran that furnace 20 odd years ago— and other experiments that were made by Mr. Glass of Milwaukee about 14 years ago, and some of these more recent experiments in which actual data has been secured, and they have all checked within limits, that, to use Mr. von Maur's friend's words, are almost uncanny.

It does not seem to me that we have gotten any further in efficiency in appliances, and I do not think that should be expected. As Mr. Forstall said, this first, somewhat crude, hot air furnace sent its products to the chimney with such a low temperature that it would have been difficult in an exposed house to have maintained chimney draught.

We have heated our offices in Milwaukee for the 15 years that it has been built, with gas and hot water heaters, and we have had the same experience there. We have tried some of the more modern copper coil heaters to replace our old, very crude cast-iron water heaters, and we do not get anywhere near the efficiency. It is simply a question of heating surface properly disposed to cut down the temperature of products of combustion. You cannot get anything more. That is all there is there.

Now I want to say something that has been very much in my mind on this house heating problem. Our salesmen are apt to talk comparative costs in handling a prospect for house heating. Let us get away from that. Why does one man pay $6,000 or $8,000 to build a house, and another man builds a

house that is but very little larger, and pays $25,000 for it? He does it for the additional conveniences and the comforts and the luxuries that he puts into the more expensive house. Why does one man drive a Ford, and somebody else spend $4,000 or $5,000 for a car that he does not get any more utility out of? He is paying for something that he thinks he gets that he would not get out of the other appliance. Why should not we frankly sell our house heating by gas on the same basis? The man that can afford to pay for creature comforts, conveniences, lack of attention to detail in any other direction, can afford to pay for it in this direction. And we give him more for his money, I believe, than for anything he buys in his home.

Mr. W. J. Serrill: Following what Mr. Brown has said, I have often wondered why wealthy people, who spend a great amount of money in other ways in their homes, and are more or less indifferent to expense, do not heat their houses with gas. There is more inducement for them to do so to-day than ever.

I ask Mr. Barrows, suppose a gas manager who has not had any experience in residence heating by gas, is approached by a wealthy consumer who wants to heat his house by gas, where could the gas manager go to get advice on what would be required? Would the existing heating appliances need to be torn out, or could they be adapted to gas heating?

Mr. H. Russell: There is one idea I would like to leave with the members, which is that at present we are doing a very considerable amount of auxiliary house heating by gas, whether we realize it or not. This is especially true on cold mornings in the fall and spring, and also in extremely cold weather in the winter time. So we really owe it to our consumers and to our stockholders, to furnish the people with the best appliances to do this work, because at present they are doing it with their ordinary gas stoves and gas lights.

This load is a very considerable one at certain times, more than most of us realize, I think.

And in connection with what Mr. Serrill said, I would like to make this statement: Some 2 years ago we installed a modern hot water heating system for a doctor in Rochester—a large house. He had several offices to rent in that house, his own living apartments being on the second and third floors. And it was a very typical house of that type. The doctor was willing to pay considerably more for the convenience of heating his offices and home by gas than he had paid for coal. Coal was selling at that time for about $6.50 per ton delivered to his house, and the rate which we charged him for gas was our regular rate of 95 cents per thousand cubic feet. The doctor's cost for heating his home was, for coal, for the two preceding winters, in the neighborhood of $300.00 per year. We made him no guarantees on the matter. The system was put in by an outside concern. We told him we would gladly co-operate, and we arranged to keep very careful records on that installation. We did, and we have the record of the meters, the record of the temperature, the measured radiation of the house, and all the necessary figures available. We know what his peak load was, what his bills per month were, etc. Now, the doctor's bill for heating with gas was about $450.00 for the 2 years in which it was in operation. He was willing to pay that amount for the convenience incurred. But at that time the reason he was compelled to throw the system out was because the mechanical difficulties with the installation were so great, so much annoyance was caused by troubles due to mechanical defects, that he was compelled to dispense with its use. Those difficulties, I believe, have been very largely overcome since that time, so that as Mr. Serrill says, if those difficulties have been overcome there is quite a large class of our customers who are willing and ready to pay considerably more for the convenience which they obtain by house heating with gas. We ought not to neglect that class of people at the present time.

THE CHAIRMAN: Mr. Winterstein, you are co-author of this paper. Would you like to add to the discussion?

MR. C. C. WINTERSTEIN (Philadelphia): I do not think, Mr.

Chairman, I have anything to say on the paper. I think Mr. Barrows brought out all the important points. Unless Mr. Barrows has anything he would like to suggest that I should speak of, I think we will let it stand.

THE CHAIRMAN: I will ask Mr. Barrows, then, to close the discussion. And if any one else has anything to contribute they will kindly do so in writing and send it to the Secretary.

MR. GEO. S. BARROWS: Mr. Winterstein has been very modest for really he wrote more of the paper than I and he can give, in great detail, much valuable information on the subject of actual and theoretical efficiencies.

I wish to call attention to the table on page 932, for which we are indebted to the American Radiator Company. It illustrates the fuel demand during a heating season and from it we see that the period of large demand is quite short. This is for Buffalo and checks up pretty well with figures I obtained several years ago, in Kansas City, of natural gas consumption for house heating. As nearly as I can recall, the average was about as follows:

	Per cent.
October	2
November	8
December	18
January	25
February	25
March	17
April	5

From these figures we see that one-half of the fuel required for an entire season of 7 months is used within a period of 2 months. It is during this period of 2 months with, probably, a few weeks on either side that gas in most cases would be much more expensive than coal which may be burned at a relatively high efficiency because of the demand for most of its heat units.

Mr. Clabaugh has referred to the use of fuel oil. Except where the price of oil is low and coal is high (relatively) it has not come into general use for residence heating, perhaps because of the attention required to keep the burners clean,

perhaps because of the odor if any is spilled while filling the tank or from a faulty joint or valve. Gravity feed is undesirable because of possible leakage and if gravity feed is not used there must be some means of forcing the oil from the storage tank to the burner.

Its use is increasing, however, and the longer we defer the introduction of proper gas burning appliances the more firmly it will be established.

I hardly agree with Mr. Brown in thinking that gas heating is a luxury and is available only by the rich. I believe that because of its ease of delivery in large or small quantities, its cleanliness, and the lack of labor entailed by its use that it is the proper fuel for those whose incomes are small and particularly for those who cannot afford to pay for assistance in the duties of the household. Certainly it is worth much to be assured of an adequate supply of fuel at all times regardless of those conditions which affect the transportation of other fuels, and which are apt to be worst at the times when fuel is most needed. It is worth much to avoid the disheartening dirt brought into the living rooms after each visit to the cellar, where much space is given over to the storage of coal and ashes, the dust from which will not "stay put." It is worth much to the tired woman with her manifold duties to be able to regulate or maintain the heat by simply turning a valve instead of the back-breaking shaking of the grate and shoveling of coal.

What these advantages are worth in dollars and cents I cannot say but I would not be surprised if we find that most people will pay 30 of even 50 per cent. more. This increased expenditure will not come, however, unless we do our part in educating our consumers and proving the justness of our claims that there is an ultimate saving.

Mr. Russell Sard: Have you any figures on the cost of heating by natural gas? I understand there are a great many installations of natural gas which are very inefficient. I wondered if you had any figures.

Mr. Geo. S. Barrows: There is available much data on heating with natural gas and I would like to see co-operation, with the Natural Gas Association of America as well as the National Commercial Gas Association.

We cannot use this data without correction factors for price of gas and heat value but the load curves should give us much valuable information, particularly as to the times we may expect peaks and we can ascertain how the send out is affected by temperature change.

The efficiencies of natural gas heating appliances now in use vary from that of a heater designed for coal and equipped with a burner made from 1 inch pipe with no mixer and a 3-foot flame, to a modern heater properly designed to burn gas.

I feel safe in saying that at the prevailing prices of natural gas and coal the former is usually somewhat cheaper than the latter when fuel cost only is considered.

Mr. Serrill has asked if it is advisable to install gas burners in coal heaters. I have never attempted to burn manufactured gas in a coal furnace but it seems to me that it should be practical to use the firebrick arch or radiant bed so commonly used for many years with natural gas. Before making such an installation for a consumer I would want to test it out pretty thoroughly and if the time for such a test was not possible then I would use one of the many types of heaters now on the market designed to burn gas.

I presume that Mr. Russell referred to portable heaters when he said that we have many opportunities for auxiliary heating at the present time. The portable heater is a great convenience and we will always need it to take care of a local condition but it was not considered when we recommended taking up auxiliary heating. We had in mind the heating of an entire house and I am sure of this none of us would care to do with portable heaters, *i. e.* those without flues and with flexible gas connections.

Mr. Russell: I think he misunderstood my remarks. What I meant was there was a lot of auxiliary house heating

being done with the gas stove and the open-flame burner at the present time, as well as the portable heater. We owe it to the consumer to supply him with better type apparatus for doing this work.

THE CHAIRMAN: I am sure the Institute appreciates the paper by Mr. Barrows and Mr. Winterstein. Undoubtedly the incoming Technical Committee will take up this question of providing committees to carry out the suggestions that Mr. Barrows has made.

We will now have the report of the Committee on Utilization of Gas Fuel Appliances. We have two reports here, and we would like to finish them before we adjourn. We are going to reconvene at 2 o'clock, to finish the three subjects that remain.

REPORT OF THE COMMITTEE ON UTILIZATION OF GAS FUEL APPLIANCES.

SPECIFICATIONS.

Gas companies again are urged to confine their use to gas ranges that are built in accordance with the gas range specification. We believe that by so doing, they will achieve economy and continued success for gas cooking. There is need for this specification in pamphlet form.

There is need also of the separate publication of the fixture specification in pamphlet form. This specification is now a standard of the Institute. The recent approval by the American Society of Mechanical Engineers of the design of threads for brass tubing, finally puts us in position to present the fixture specification in completed form. This is shown in Exhibit "A."

The question is often asked if the American Gas Institute's specifications for gas ranges and gas fixtures are the same as the specifications adopted by the National Commercial Gas Association. Since these specifications are identical, we recommend that an agreement be made with the National Commercial Gas Association for the joint publication of these pam-

phlets under the titles, "Standard Gas Range Specification, Adopted Jointly by the American Gas Institute and the National Commercial Gas Association," and "Standard Gas Fixture Specification, Adopted Jointly, etc., etc."

Flexible Tubing and its Connections.

A standard specification of flexible tubing, describing the composition and construction in detail, is demanded by the industry. Increasing agitation in the cause of safety, the imposition of ever stricter requirements by fire prevention authorities, and a proper regard for the essential interests of the industry call for the production of a flexible tubing that shall be substantially as safe as a rigid metal pipe. We need a tubing in which it is safe to allow the gas pressure to remain at all times.

To meet the requirements, the tubing must (*a*) be sufficiently flexible to hang in a graceful natural curve, (*b*) maintain its flexibility unchanged throughout its life, (*c*) be non-crushable under the heel of a person of ordinary weight, (*d*) be non-breakable and gas-tight when subjected to extreme bending, (*e*) be non-combustible, in the sense that if all the outer coverings are burned off, the metal base of the tubing still will retain its form, and the leaking gas will be so small in volume that the flames at 3-inch pressure will be not over 1½ inches long, (*f*) if caused to leak by mechanical injury, or by fire, develop only small, non-dangerous leaks, so long as the tubing maintains its form, (*g*) not absorb the moisture from the atmosphere, (*h*) if uninjured, remain gas-tight indefinitely, and (*i*) permit of the attachment of metal ends in such a way that they cannot be pulled off.

The tentative specification given in Exhibit "B," we believe, describes a tubing that will meet these requirements. The spiral metal base gives the required strength, flexibility, non-collapsibility, non-combustibility and security of attachment for the metal ends; the composition coating lends the desired gas-tightness and uniformity in elasticity and plasticity; the two wrappings of oiled paper protect the elastic coating from

mechanical abrasion and from the moisture of the atmosphere; and the woven outer covering contributes the good looks.

This specification is submitted for consideration and criticism, with the thought that at the 1917 meeting, it will be ripe for adoption as a standard of the Institute.

But, it will be asked, no matter how perfect the tubing may be in itself, will it ever be good practice to arrange for leaving the gas in the tubing at all times, so long as it is connected at its two ends, or at either of them, by the slip joint? We think not. When the slip joint is used, no cock should be permitted at the consumption end of the tubing. Several years ago, this committee took a decided stand in opposition to the slip joint, and said that we hoped for its ultimate abolition. Our position has in no whit changed. We still believe it to be for the interest of the industry that an acceptable substitute be found. We realize, however, that, even if a practicable substitute be adopted, a long period of transition must elapse, and that, at best, the slip joint will continue in use to a greater or less extent for a number of years.

Under this condition, it seems worth while to standardize the slip joint. This work has just been thoroughly and effectively done by the Appliance Committee of the National Commercial Gas Association, and we take pleasure in submitting in Exhibit "C," the design and specification of the standard slip joint that has been so perfected. The object in designing this joint has been to have the metal nozzle and the rubber end so adapted to each other, and to have the rubber end of such degree of elasticity and pliability, that the end may be easily pushed onto the nozzle, and, by working back and forth, may be easily taken off the nozzle, and yet that it will be very difficult to pull off by a straight pull in any one direction,—either a direct pull or a side pull,—such as an accidental pull always is. We urge those gas companies who have occasion to use the slip joint, to take pains to assure themselves that this standard design is used, and we urge all manufacturers of appliances to discard their old slip-joint nozzles, of whatever form, and to adopt the standard design of nozzle here shown.

There is no question but that the use of this approved design of slip joint will contribute materially to the safety of this form of connection.

In the meantime, gratifying progress has been made in the development of a substitute joint. The design shown in Exhibit "D" has been tried out quite thoroughly in one situation during the past year, both in consumers' houses and in laboratory experiment. In the latter, fifty of the joints were mounted under gas pressure on a bar, and the parts were rotated daily,—so that a new tubing piece met a new fixture piece—until each joint had been moved 150 times. In making up the joints, no more force was exerted by the fingers than the consumers would naturally use in practice. At the end, after 150 moves, the joints were as gas-tight, and in as good condition, as at the start. As the two pieces of this joint, after it had been made up by hand, are held together by a screw thread, and as the nozzle of the tubing piece (the nozzle which enters the end of the tubing), is of spiral construction so as to fit the spiral construction of the metal base of the proposed standard tubing—so that the tubing piece of the joint is really screwed to the tubing itself—it is evident that this joint cannot be accidentally pulled apart. It is all screwed together, and is as safe from unintentional rupture as is an iron pipe thread.

A supply of these joints has been furnished to the members of this committee, and to certain gas companies in other cities than those represented by the members, so that a more extended trial may be made during the coming year.

If further trial confirms the experience here described, this joint may be taken as a successful substitute to the slip joint. It is reasonable in cost; it may be made and unmade by the fingers indefinitely; the tubing pieces of the joint may indifferently be joined to other fixture pieces; and it cannot possibly pull apart. It will be noted that when an appliance is connected by means of the proposed metal base standard tubing, which is joined to the appliance by a screwed thread, and joined to the house piping by the safety joint just described, we have what is really a metal to metal connection

throughout, and as safe for the continuous occupation of gas under pressure as is any other portion of the house piping. And yet it is a portable connection, in the sense that it may be made and unmade without a tool, and that the appliance and tubing, with its half of the joint, may be moved to another room and made up by the fingers to the fixture half of another joint.

Industrial Appliances.

Several factors are combining to bring the use of gas for industrial purposes into greater prominence and to encourage and warrant increased attention by gas managers everywhere to this branch of their business. These factors are:—the cumulative educational effect on manufacturers of increased efforts of the gas men to introduce gas for industrial purposes; the increased efforts by gas appliance makers to meet the needs of every opening for the use of gas; the great development of factories and processes of a class suited to gaseous fuel; the rising prices of competing fuels, as oil and coal; the growing practice of gas companies to make graded rates to large consumers; and last, to some extent, the stimulus of competition due to the strong and persistent efforts of the electrical industry to appropriate as far as possible this same field of industrial fuel.

As gas lighting has been threatened by the successful competition of the electric light, so, in a lesser degree, is the electric furnace beginning to compete with the gas furnace. In some localities, the electric companies have made very low rates for this class of service, rendering the electric furnace, in such places, a real competitor to the gas furnace.

An enormous outlet for gas consumption awaits the gas industry, provided it strives to obtain it now, and actually gains possession of it; but the industry must be alert. It is far easier to defend a ground already occupied than to recover it after it has been lost. Not only should great energy be applied now towards this end, but the best of service and latest of engineering methods should be employed in industrial in-

stallations. The services of skilled, experienced engineers should be adopted. Such gas companies as have no men of this type can get expert advice and special designs from several companies whose specialty is the designing and making of gas appliances for the industrial field. In some places, and for many purposes, it will be found necessary to establish low rates for gas used industrially over long hours and in large quantities. The gas man who proceeds on the above lines has every reason to take an optimistic view, and will achieve the success for which he strives.

Special attention is required for that class of industrial installation, in which a number of operatives, each using his own torch or burning appliances, is grouped in one room. The tendency of some of the numerous appliances to get out of perfect adjustment, either accidentally or through ignorance of the operators, and consequently to deliver a modicum of the products of incomplete combustion into the room, thus vitiating the atmosphere, should be guarded against. In some cases, this condition has brought the use of gaseous fuel into disrepute. Gas men are advised to investigate the several systems now on the market, in which a perfect pre-mixture of gas and air is made and delivered to the operatives' burners. In this case, there is nothing to adjust or get misplaced at the burner, and perfect combustion is assured. Such pre-mixture systems must, of course, be provided with adequate means to prevent back-firing and explosion at the mixing machinery. These means are well developed at the present time.

Room Heating.

Reference is made to this committee's report to the Institute for the year 1912, where, in Exhibit "C," a study is given of the distribution and quantity of radiant heat emitted by several types of gas room heaters. This year, the committee, by using the method of experiment then employed, has determined similar information regarding types of heaters that were not available at that time. The results of these tests are shown in Exhibit "E."

The committee believes there is need for further development in this country of gas fireplace heaters of the "radiant fire," or similar, type so much in vogue in England. Samples are being collected, and thought is being given to suggestions arising from the Fireplace Heater Competition, that was held last year, with the view of advancing such development.

Cooking Appliances.

The committee has under way a test comparing the various efficiencies of several types of cooking appliances, but the data on this test are not in shape so that proper conclusions may be drawn for inclusion in this report.

The committee wishes to draw the attention of the members of the Institute to the excellent papers presented at this meeting, which have to do with the work of this committee.

Exhibit A.—Specification for Gas Fixtures.

General:

Gas fixtures should be of such mechanically good construction that proper installation, operation and maintenance will be assured without encountering any special difficulty.

Care should be exercised in the design of the fixture, so that no portion of it interferes with ready access to any nut or screw, which it may be necessary to get at for purpose of adjustment.

Brass pipe or tubing should be either seamless, drawn or brazed; in either case of best quality to allow bending and threading without splitting.

The thickness of walls of brass pipe or tubing should be not less than No. 18 B. & S. gauge (0.04030 in.) except when it is used as casing or covering for iron pipe, in which case it should be not less than 22 B. & S. gauge (0.02534 in.). Both of these gauges are subject to the usual gauge tolerance of + or — 0.002 in.

Particular attention should be paid to having tubing which runs the full gauge.

(While No. 18 gauge is very generally in use, it is believed

that it is very much better to use No. 17 gauge. This is not because the 18 gauge tubing is not strong or rigid enough, but because when threads are cut on it, there is not sufficient metal to be sure that a good joint is made. If the 18 gauge always ran full size, or a little over size, there would be no objection to its being used, but as it is necessary to allow some variation in the gauge of tubing, it is thought that the No. 17 gauge should be specified.)

Iron pipe should be of the American standard size.

No. 1: Sizes of Threads:

(A) All threads on brass tubing should be straight threads to conform to the standard specification of the American Society of Mechanical Engineers for such threads, as printed hereafter.

(B) All pipe threads for iron pipe should be the standard iron pipe size. (Briggs standard.)

(C) When brass tube and iron are connected, the thread should be gas fixture size brass tubing thread, on both the brass and the iron, but it is recommended that, where possible, instead of connecting the parts in this manner, a brass bushing be used, threaded on the outside with a standard I. P. S. thread to screw into the iron body, the bushing being tapped on the inside with a straight gas fixture size brass tubing tap, for the connection of the brass tube.

No. 2: Assembling Requirements:

(A) Joints of the stems or arms at the body should be well threaded and depend on the thread for strength.

All joints connecting tubing to cocks or nozzles should be threaded where possible, and brazed.

(B) The threaded portion of pendant body, or manifold, for fixture stem to be of such a depth that in no case will the stem come in contact with the arms. The pendant body should be threaded for at least four full threads, both for the stem and arms.

(C) Fixture arms should not extend into the pendant body, or manifold, for a greater distance than the threaded portion of the manifold.

(D) If the arms of the pendant are straight, then the pendant body, or manifold, should be drilled in such a way that the arms will be perpendicular to the stem.

(E) The burner nozzle, or nipple, to have a $\frac{1}{8}$-inch iron pipe, male thread. The length of this threaded portion should be not less than $\frac{9}{32}$-inch and not more than $\frac{11}{32}$-inch, and the bottom of the thread should be recessed so that the burner will make a neat, tight joint, with the finished end of the arm immediately before the threaded portion.

(F) The axes of the burner nozzles should be vertical.

(G) Special precautions should be taken in the construction to prevent the obstruction of the gas-ways by foreign matter, such as gas fitters' cement, solder, or other jointing material, or metal chips. The ends of tubing should be reamed to remove burrs. When duplex tubing is used, care should be exercised to prevent faulty alignment of the gas-ways.

(H) Gas fitters' cement should not be used on any part of the fixture where it may be affected by the heat from the burners. When solder is used, it should be of such a mixture that it will not be affected by the heat from the burners.

(I) Fixtures for use out of doors, or in exposed situations, should be provided with suitable drips, or means for the convenient removal of condensation from any part of the fixture in which such condensation may accumulate. Independent pilot lines in outdoor fixtures should be not smaller than $\frac{3}{8}$-inch iron pipe size.

(J) Globe holders should be of such construction and weight that they will support properly without sagging or bending, any globe or shade, with which they are intended to be used. They should be readily and rigidly attached to the fixture arm or portable stand, and held in place by screwing down the burner, or by other means. They should provide a

good seat for all parts of the globe with which they are supposed to be in contact. Eyelets should be inserted where screws are used for holding the globe, these eyelets to be of such a size that they will provide at least three full threads.

(K) When a fixture has two cocks at the body, the cocks should be so placed that the keys will be, at all times, at least 1 inch apart in the clear.

No. 3: Goose or Stork Neck:

(A) The thread on a fixed portion of a goose or stork neck should be not less than $^{9}/_{32}$-inch in length, and should be threaded with ⅛-inch I. P. S. thread.

(B) The ground joint between the fixed and movable portions should have a bearing surface of not less than 1 inch, and the diameter of the small end of the ground joint should be not less than ⅜ inch.

(C) The joint should be thoroughly and properly ground and not merely tool-finished. It should be perfectly gas tight, without grease under a pressure of 8 inches water column. The joint may be tested for satisfactory grinding by wiping the plug and body free from grease and putting on the plug a small quantity of dry red lead or chalk. The plug when turned in the body should then show neither high nor low places.

(NOTE.—A water column 8 inches high is the equivalent of a mercury column $^{6}/_{10}$ inch high, and represents a pressure of about ⅓ of a pound per square inch.)

(D) It should be possible to lock the movable part to the fixed part by a bayonet lock, or approved means.

No. 4: Casing:

Where casing is used, it should be cut to an exact length, so that the joints may be made up tight, without marring or jambing the parts of the fixture at either end of the casing.

No. 5: Chain Pulls:

(A) Where a by-pass chain passes through a part of the casing, or an ornament of the fixture, the opening through

which the chain passes should have an eyelet, or similar means, to prevent the links of the chain from catching on the edges of the opening. If a rod is used in place of a chain, the eyelet may be omitted.

(B) If a chain pull is to be used, a sample of such chain should be submitted for examination and approval.

No. 6: Cocks on Portable Stands:

A portable stand should not have a cock as part of the stand.

No. 7: Swing Joints:

The committee desires to go on record as being opposed to the use of brackets having swing joints. It is felt that in practically all cases they are unnecessary, and they are without doubt a source of much annoyance and expense, unless well constructed and properly installed and used. The use of swing joints is being noticeably lessened, but because there is still some demand for fixtures of this type, the following suggestions should be carefully followed:

(A) In fixtures having swing joints, the swing joint should be constructed in accordance with the specification for the gas fixture cock in so far as that specification may cover the plug, the gas-way and the lock nut and jamb nut. It is to be understood that in no case shall the diameter of the plug at the small end be less than ⅜ inch. In no case shall the gas-way around the plug be less than ⅛ inch wide and $^1/_{16}$ inch deep.

(B) Fixtures having swing joints should be so made that the arms of the fixture will, at all times, be in parallel horizontal planes, and the construction should be sufficiently heavy, so that the arms will maintain substantially these positions when a lamp of any weight up to 2¼ pounds is attached. (The deflection with a weight of 2¼ pounds should not be over ½ inch.) Exception:—Fixtures which are intended to revolve in planes other than horizontal planes, need not conform with this clause of the specification, but should be submitted for examination and approval.

(C) Swing joints should be so assembled, that the weight of the fixture has a tendency to seat the plug in the body.

No. 8: Center Control Cocks:

(A) A center control cock, which is the cock used for controlling the supply of gas to a fixture having two or more arms, and which may or may not be at the same time a by-pass cock, should have, in all cases, a $^3/_{16}$-inch gas-way, and in other dimensions, should conform with the gas fixture cock specification appended hereto.

(B) If this center control cock has lever arms, these arms should be of sufficient length to permit of easy operation of the cock, so that neither the arms, nor the rods, nor the chains, operating the cock, come in contact with the body arms or other parts of the fixture.

No. 9: Grease:

The grease used on cocks, or swing joints, should not contain resin, rubber, paraffine or similar substance. When the cocks are exposed to heat, as in the case of a by-pass cock over an inverted incandescent lamp, the grease should be made of a good quality of gas engine cylinder oil and graphite, in proportions of about 1 pound of graphite to 1 pint of oil. This grease is also preferred for use with all cocks. Where this lubricant is not used, a satisfactory grease is one made of pure beeswax and a good quality of tallow or lard, in about the proportions of 3 parts of beeswax to 2½ parts of tallow or lard. It is recommended that a small quantity of gas engine cylinder oil be added to make the grease thinner.

No. 10: Sizes of Pipe or Tubing Used in Fixture Stems:

(A)

	Maximum No. of lights	When made of iron pipe		When made of brass tubing	When made of brass chain gas-way down		Size of gas-way through cock
		Cased Inch	Uncased Inch	Inch	Both sides Inch	Center or one side Inch	Inch
23″ and under	1	⅛	¼	⅜	¼	¼	$^1/_8$
33″ and under	2	¼	¼	⅜	¼	⅜	$^3/_{16}$
Over 33″ & under 42″	2	¼	⅜	½	⅜	⅜	$^3/_{16}$
Over 42″ & under 72″	2	⅜	⅜	½	⅜	⅜	$^3/_{16}$
Any length to 42″	4	⅜	⅜	½	⅜	⅜	$^3/_{16}$
Any length 42″–72″	4	⅜	⅜	½	⅜	⅜	$^3/_8$
Any length 42″–72″	7	⅜	½	¾	⅜	½	$^1/_4$
Any length 42″–72″	12	½	¾	¾	⅜	½	$^5/_{16}$
Any length 42″–72″	20	¾	1	1	½	⅝	$^3/_8$

NOTE.—When made of duplex tubing, the area of the main gas-way should be equivalent to the area of the corresponding brass pipe size in the above table. Fixtures not covered above, or having a drop of more than 6 feet, or having more than 20 lights, use size of pipe according to the company's piping rules.)

(B) "Length of Stem" is understood to be the distance in a straight line from the stiff joint to the lowest point of the pendant. In the case of wall brackets, which carry more than one burner, the sizes given in the table are correct, except that no pipe smaller than ¼ inch should be used. In brackets which carry more than one burner, the "Length of Stem" is understood to be the distance from the stiff joint to the point where the arms diverge.

(C) Sizes of pipe or tubing to be used in one-piece or harp pendants:

Number of lights not exceeding	Harp (Maximum size 18″ x 12″)		Stem (Maximum length 36″)	
	Iron pipe Inch	Brass tubing Inch	Iron pipe Inch	Brass tubing Inch
1	⅛	⅜	¼	½
3	¼	½	⅜	½
5	⅜	½	⅜	¾

No. 11: Sizes of Piping or Tubing for Arms:

(A) Arms of pendants, or of wall brackets, *i. e.*, those parts which carry gas for only one burner, should be made not smaller than the following sizes:

Length of arm	When made of iron pipe		When made of brass pipe Inch
	Cased Inch	Uncased Inch	
12″ and under	⅛	¼	5/16
Over 12″ to and including 18″	¼	¼	3/8
Over 18″ to and including 24″	⅜	⅜	1/2
Over 24″	⅜	⅜	5/8

(NOTE.—When over 24 inches in length, the arms should be properly supported by some means other than their attachment to the wall outlet in case of a bracket, or the body in case of an arm.)

(B) "Length of Arm" is understood to be a distance measured as follows:

In pendants—a straight line from the center of the stem to the center of the burner nozzle.

In stemless wall brackets, like stiff brackets, or single swing or double swing brackets, carrying but one burner—a straight line from the stiff joint to the center of the burner nozzle, measured when the bracket has its maximum reach.

In stemmed wall brackets—a straight line from the point of divergence of the arm to the center of the burner nozzle.

(C) In the case of cast wall brackets or cast arms, the area of the gas-way in stems or arms should be not less than the area of the equivalent pipe or tubing, specified in Section 11, Par. A.

No. 12: Cocks:

All cocks, including arm cocks, center control cocks, lantern cocks, or any other shut-off cock, should be made in accordance with the "Specification for Gas Fixture Cocks." By "shut-off cock" is meant any cock intended to be used for completely shutting off the gas supply to a burner or burners.

Specification for Gas Fixture Cocks.

It is not intended that this specification shall in any way govern the design of fixture cocks, except in so far as the dimensions given may govern the size. The accompanying drawing, which is on a large scale, is merely conventional, and is intended to show only the dimensions referred to in the specification.

(1) The material of both plug and body should be free from all defects, and of such grade that constant use will not cause excessive wear.

(2) The end of the plug should have two flat sides for the washer, and two nuts—a main nut and a jamb nut—should be used instead of a tail screw (Boston type). The plug and the male thread on the end of the plug preferably should be made of one piece; if made of two pieces, the nipple forming the

male thread on the end of the plug should be screwed, and sweated with hard solder, into the plug.

(3) The bearing surface for the washer on the cock body should be not smaller in diameter than the diameter of the washer. The washer should wear evenly on the face of the body.

(4) The plug should stop at 90 degrees in either direction when shut off, but when the cock in question is a main by-pass cock, it may be a quarter-turn cock. The plug should be carefully tool-finished, and thoroughly and properly ground. It should never be left in the tool-finished state. The question of thorough grinding is of great importance; any sign of insufficient grinding will lead to the rejection of the cock. The cock should be perfectly gas-tight, without an excess of grease, under a pressure of 8 inches of water column, while the plug may be turned by hand. The cock may be tested for satisfactory grinding by wiping the plug and body free from grease, and putting on the plug a small quantity of dry red lead or chalk. The plug, when turned in the body, should then show neither high nor low places.

(5) For turned cocks, the thickness (F) of the body wall at the gas-way should be not less than $^3/_{32}$ inch. For cast cocks, the thickness of the body wall at any point, including the part that forms the miter, should be not less than $^3/_{32}$ inch.

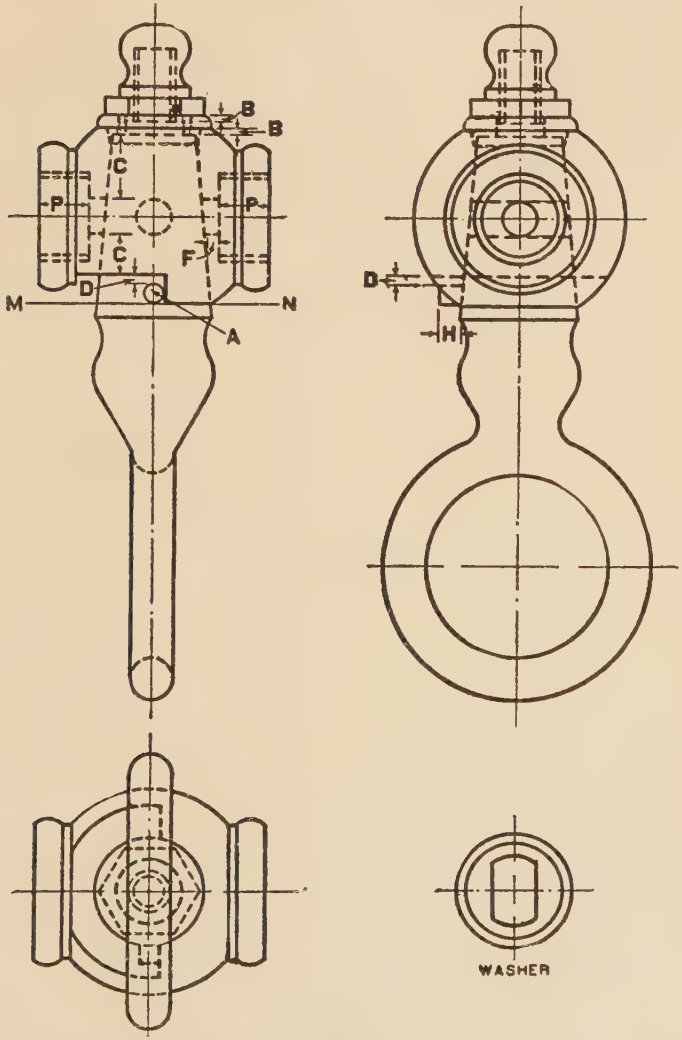
(6) The tapered hole through the body should be recessed at the small end to a diameter at least 0.003 inch larger than the diameter of the small end of the plug; this is done to prevent the formation by wear in grinding of a shoulder in the small end of the tapered hole in the body.

(7) The gas-way through both the body and the plug should be not less than $^1/_8$ inch diameter. The gas-way in the plug should register with the gas-way in the body.

(8) Neither of the two distances (B) provided to take up for wear, should be less than $^1/_{32}$ inch.

(9) Neither of the two bearing surfaces (C) on either side of the gas-way, should be less than $^3/_{16}$ inch in length.

(10) The distance (D) provided to take up for wear, should be not less than $^1/_{32}$ inch.



(11) The seal between the gas-ways in plug and body, when the key is hard over, should be not less than $^3/_{16}$ inch in length.

(12) The stop pin (A) should be either screwed or driven into place. If a driven pin is used, it should be made of soft annealed metal.

(13) Diameter of the stop pin; if a driven pin, not less than $^1/_{16}$ inch, if a screwed pin, not less than $^3/_{32}$ inch. No portion of any $^1/_{16}$ inch diameter pin should extend below the miter—*i. e.*, below the line MN.

(14) Length (H) of the stop pin should be not less than $^1/_{16}$ inch.

(15) The key and the gas-way should be straight on the axis of the body when gas is on.

(16) The key and the plug preferably should be formed of one piece of metal; if not, the two pieces should be firmly attached by sweating with hard solder.

(17) The cock body should have at the screw joint (P) not less than 5 full threads.

Specification of Threads for Fixtures and Fittings on Straight Pipe Threads by the American Society of Mechanical Engineers.*

(At the end of this Specification for Threads is given a specification of threads for electric socket caps and nipples. While these are no necessary part of a specification of threads for gas fixtures, it has been thought advisable to retain them here, as they form a portion of the specification as approved by the American Society of Mechanical Engineers.)

Definitions of Terms Used.

The term "outside diameter" used in this report, refers, in the case of male threads, to the top of the threads or largest diameter, and in the case of female threads, to the bottom of the threads or largest diameter. The term "root diameter" similarly refers to the smallest diameter. The "pitch diameter" is, of course, determined by subtracting from the outside diameter of a theoretical full V-thread, the single depth of the thread. Fig. 1 illustrates these various diameters.

Straight Threads.

2. This report is in no way to be considered as recommend-

* Presented at the Annual Meeting, December, 1915, of The American Society of Mechanical Engineers, 29 West 39th Street, New York, N. Y.

ing the use of straight pipe threads on pipe in place of taper threads made to the American Briggs Standard. On certain classes of female fittings, however, straight pipe threads are used with entire satisfaction when the engaging male thread is taper and to American Briggs Standard, as a "make-up" non-leaking joint is obtained. The use of straight male threads under these conditions, is therefore not to be recommended, as an excessive amount of cement is necessary to pre-

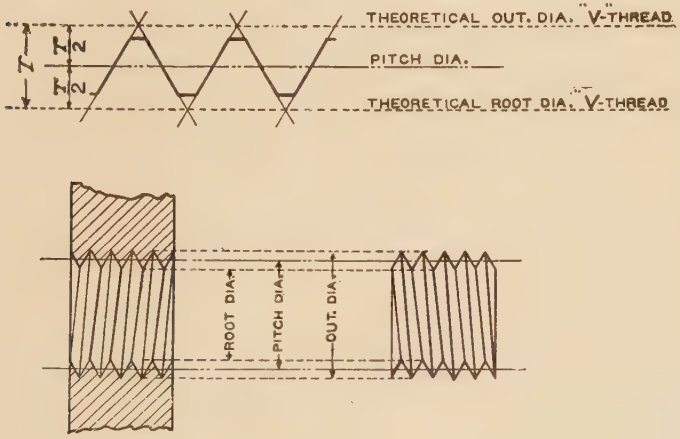


FIG. 1 OUTSIDE, PITCH AND ROOT DIAMETERS

vent leaks. Often, however, in fixture work, such a joint is not necessary, and is in many cases undesirable for purposes of finish, and in such cases, straight male threads may be used to advantage. It will be manifest, upon inspection of the figures given in Tables 1, and 3, that a female-threaded fitting will not screw down to the end of the thread, but will "make-up" at a proper point which is normally to be desired; further, from inspection of Tables 1 and 5, that the ⅛-inch socket caps will screw down to the end of the thread without "make-up," which in this particular case is desired. Also, by comparison of Tables 2 and 3 together and Tables 2 and 5 together, it will be noted that the female fitting will not "make-up" at any point, but will

show a slight looseness at all points, making the use of a considerable amount of cement necessary if a non-leaking joint is desired.

Basic Sizes.

3. The notch on the American Briggs Standard, which is located by the thickness of the American Briggs Ring, is well recognized as locating the proper point on the standard for the measurement of the pitch diameter of straight pipe size threads. The thickness of this ring was recommended for each size of pipe by the Committee on Standardization of Pipe Thread Gauges appointed by The American Society of Mechanical Engineers, working in conjunction with the Committee of Manufacturers on Standardization of Valves and Fittings. Further, this latter committee adopted the sizes at the notch as correct for straight pipe threads. The angle, form and pitch of the thread are, of course, the same as on the American Briggs Standard.

Formulae for Basic Sizes.

4. *Pitch Diameter.*—The report of the Committee on Standard Pipe and Pipe Threads, presented to The American Society of Mechanical Engineers in 1886, Paper CCXXVI, and, supplemented by the report of the Committee on Gauges above mentioned, gives standard dimensions of pipe and certain formulae shown in Fig. 2. In this figure

$$L = \frac{0.8D + 4.8}{n} \qquad E = L + 2\left(\frac{1}{n}\right)$$

$$R = D - \frac{0.05\,D + 1.9}{n} \qquad A = R + \frac{0.8}{n}$$

$$B = A + \frac{F}{16} \qquad G = A + \frac{E}{16}$$

$$H = \frac{1}{16\,n}$$

5. The sizes shown in Fig. 2 and above described were adopted by the Committee of Manufacturers on Standardization of Fittings and Valves on September 17, 1913, except

the straight pipe thread and the lock-nut sizes, which were later adopted by the same committee on March 16, 1915. The figures for the various pipe sizes, as published by that committee, are given in Table I, with the addition of columns

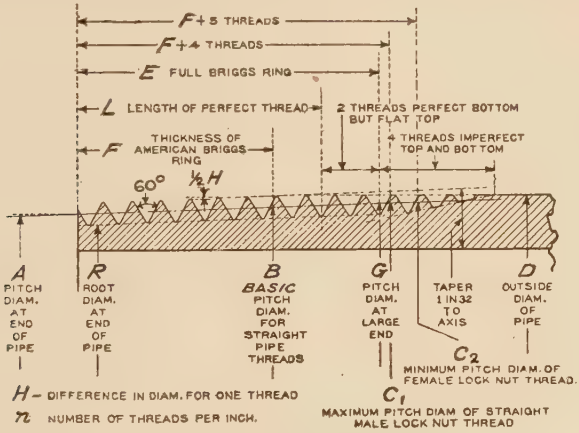

F + 5 THREADS
F + 4 THREADS
E FULL BRIGGS RING
L LENGTH OF PERFECT THREAD
2 THREADS PERFECT BOTTOM BUT FLAT TOP
4 THREADS IMPERFECT TOP AND BOTTOM
F THICKNESS OF AMERICAN BRIGGS RING
60°
½H
A PITCH DIAM. AT END OF PIPE
R ROOT DIAM. AT END OF PIPE
B BASIC PITCH DIAM. FOR STRAIGHT PIPE THREADS
G PITCH DIAM. AT LARGE END
TAPER 1 IN 32 TO AXIS
D OUTSIDE DIAM. OF PIPE
C2 MINIMUM PITCH DIAM. OF FEMALE LOCK NUT THREAD.
H – DIFFERENCE IN DIAM. FOR ONE THREAD
n NUMBER OF THREADS PER INCH.
C1 MAXIMUM PITCH DIAM OF STRAIGHT MALE LOCK NUT THREAD

Fig. 2 Basic Straight Pipe Sizes

headed *D*, *G* and *H*. Your committee heartily endorses the work done by the Committee of Manufacturers on Standardization of Fittings and Valves.

Tolerances.

6. The maximum tolerances taken on the pitch diameters by the Committee of Manufacturers on Standardization of Fittings and Valves are one thread above and one thread below *basic* sizes or a total of twice *H*, Table I.

7. While your committee recommends the same *basic* sizes as the above committee, and concurs with it in its recommendation for tolerances on pipe fittings with straight threads, yet, for the special fittings below mentioned, it is necessary to use different tolerances. The straight pipe threads recommended by the Committee of Manufacturers are used almost universally on female fittings only, and the tolerance that is taken above and below *basic* size, is therefore eminently a proper one. This is not the case, however, when both male

TABLE I.--AMERICAN BRIGGS PIPE STANDARD LOCKNUT THREADS AND BASIC STRAIGHT PIPE SIZES.

Pipe size in.	Threads per in.	Depth thread	Pitch diameter end of pipe	Pitch diameter at notch *basic* straight	Maximum pitch diameter straight male locknut thread	Minimum pitch diameter straight female locknut thread	Outside diameter pipe	Thickness full briggs ring	Inches thickness American briggs ring	Pitch diameter at large end	Difference in diameter one thread
	n	$\frac{0.8}{n}$	A	B	C_1	C_2	D	E	F	G	H
⅛	27	0.02962	0.36350	0.37475	0.38400	0.38632	0.405	0.2638	0.180	0.37999	0.00232
¼	18	0.04444	0.47739	0.48989	0.50378	0.50725	0.540	0.4018	0.200	0.50250	0.00347
⅜	18	0.04444	0.61201	0.62701	0.64090	0.64437	0.675	0.4078	0.240	0.63750	0.00347
½	14	0.05714	0.75843	0.77843	0.79628	0.80075	0.840	0.5337	0.320	0.79179	0.00446
¾	14	0.05714	0.96768	0.98886	1.00671	1.01118	1.050	0.5457	0.339	1.00179	0.00446
1	11½	0.06956	1.21363	1.23863	1.26036	1.26580	1.315	0.6828	0.400	1.25630	0.00543
1¼	11½	0.06956	1.55713	1.58338	1.60511	1.61055	1.660	0.7068	0.420	1.60132	0.00543
1½	11½	0.06956	1.79609	1.82234	1.84407	1.84951	1.900	0.7235	0.420	1.84131	0.00543
2	11½	0.06956	2.26902	2.29627	2.31801	2.32344	2.375	0.7565	0.436	2.31630	0.00543
2½	8	0.10000	2.71954	2.76216	2.79341	2.80122	2.875	1.1375	0.682	2.79063	0.00781
3	8	0.10000	3.34063	3.38850	3.41975	3.42756	3.500	1.2000	0.766	3.41563	0.00781
3½	8	0.10000	3.83750	3.88881	3.92006	3.92787	4.000	1.2500	0.821	3.91563	0.00781
4	8	0.10000	4.33438	4.38713	4.41838	4.42619	4.500	1.3000	0.844	4.41563	0.00781
4½	8	0.10000	4.83125	4.88593	4.91718	4.92499	5.000	1.3500	0.875	4.91563	0.00781
5	8	0.10000	5.39074	5.44930	5.48055	5.48836	5.563	1.4063	0.937	5.47863	0.00781
6	8	0.10000	6.44610	6.50597	6.53722	6.54503	6.625	1.5125	0.958	6.54063	0.00781
7	8	0.10000	7.43985	7.50235	7.53360	7.54141	7.625	1.6125	1.000	7.54063	0.00781
8	8	0.10000	8.43360	8.50003	8.53128	8.53909	8.625	1.7125	1.063	8.54063	0.00781
9	8	0.10000	9.42735	9.49797	9.52922	9.53703	9.688	1.8125	1.130	9.54063	0.00781
10	8	0.10000	10.54532	10.62094	10.65219	10.66000	10.750	1.9250	1.210	10.66563	0.00781

For sizes above 10 in., the formulae in Par. 4 also should be used.

and female fittings have straight threads, and a careful survey of the product in consultation with manufacturers and users developed that the following maximum tolerances be allowed on pitch diameters.

0.004 inch on ⅛-inch pipe size.
0.005 inch on ¼-inch and ⅜-inch pipe size.
0.006 inch on ½-inch and ¾-inch pipe size.
0.007 inch on 1-inch pipe size.

8. These tolerances should be taken over *basic* sizes for female fittings, and under *basic* sizes for male fittings. When female fittings with these tolerances are used with male fittings made taper to American Briggs Standard, a proper "made up" joint will result. One inch is the largest pipe size in use on this work.

9. In order to allow sufficient wear for taps and dies, and as it is further recognized that a thread three-quarters full depth is not too flat for commercial practice, it is recommended that the minimum outside diameter of female threads and the maximum root diameter of male threads be made United States Standard, and that the maximum root diameter of female threads and the minimum outside diameter of male threads be such that three-quarters of the depth of a full V-thread results. The maximum outside diameter of female threads, and the minimum root diameter of male threads purposely are not specified, so that manufacturers may, if so desired, start their taps and dies full V-thread, and allow them to wear to the specified limits above given. All calculations for root and outside diameters should be based on the pitch diameters.

10. The length of thread should be not less than the full Briggs ring (*E* in Par. 4).

11. Threaded gauges should be made primarily to check the pitch diameters. The maximum allowable flatness of thread should be checked by plain gauges. Gauges for female fittings made to maximum sizes should not enter, and made to minimum should enter, the fittings. Gauges for male fittings made

to maximum sizes should be entered by, and made to minimum sizes should not be entered by, the fittings. This will ensure the fittings being made with less variation than the allowed tolerances.

12. *Gauge Dimensions.*—It will be noted above that a flatness of three-quarters of a full V-thread is recommended in extreme cases. This is to cover commercial practice in tapping and threading sheet metal shells. Working gauges for fittings turned from rod may, however, ignore this allowance. Further, in order that the pitch diameter may always properly be gauged, clearance should be allowed on the outside thread diameters of the gauges; Fig. 3 and the dimensions given below in connection with Tables II, III, IV, and V, cover these points.

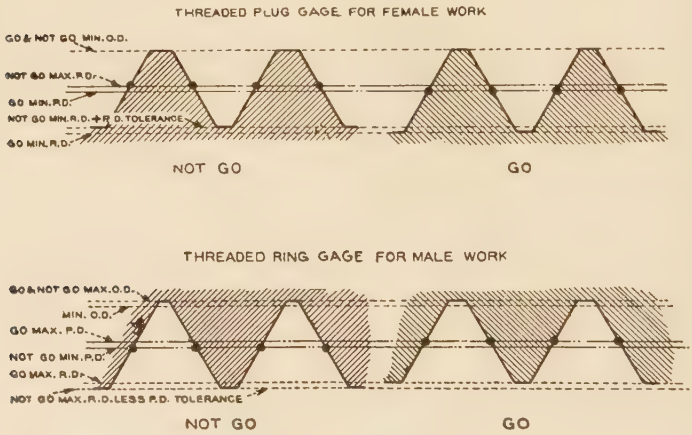


FIG. 3 "GO" AND "NOT GO" GAGES

FOR MALE FITTINGS.

Reference Gauges.

"Not Go" Threaded Ring.

Outside diameter = maximum.
Pitch diameter = minimum.
Root = maximum less pitch diameter tolerance.

"Go" Threaded Ring.

Outside diameter = maximum.
Pitch diameter = maximum.
Root = maximum.

"Not Go" Plain Ring.

Diameter = minimum outside diameter.

"Go" Plain Ring.

Diameter = maximum outside diameter.

Working Gauges.

For sheet metal work same as reference gauges above.

For turned work threaded rings and "Go" plain ring, same as reference gauges above.

"Not Go" Plain Ring.

Diameter = maximum outside diameter less pitch diameter tolerance.

For Female Fittings.

Reference Gauges.

"Not Go" Threaded Plug.

Outside diameter = minimum.
Pitch diameter = maximum.
Root diameter = minimum plus pitch diameter tolerance.

"Go" Threaded Plug.

Outside diameter = minimum.
Pitch diameter = minimum.
Root diameter = minimum.

"Not Go" Plain Plug.

Diameter = maximum root diameter.

"Go" Plain Plug.

Diameter = minimum root diameter.

Working Gauges.

For sheet metal work, same as reference gauges above.

For turned work, threaded plugs and "Go" plain plug same as reference gauges above.

"Not Go" Plain Plug.

Diameter = minimum root diameter plus pitch diameter tolerance.

Formulae for Tolerances.

13. The tolerance on pitch diameter will be shown as T, so referring to Par. 4 to 13 we have:

MALE FITTINGS

Maximum pitch diameter $= B$

Maximum root diameter $= B - \frac{0.64952}{n}$

Maximum outside diameter $= B + \frac{0.64952}{n}$

Minimum pitch diameter $= B - T$

Minimum outside diameter $= B - T + \frac{1}{2}\left(\frac{0.86603}{n}\right)$

FEMALE FITTINGS

Maximum pitch diameter $= B + T$

Maximum root diameter $= B + T - \frac{1}{2}\left(\frac{0.86603}{n}\right)$

Minimum pitch diameter $= B$

Minimum root diameter $= B - \frac{0.64952}{n}$

Minimum outside diameter $= B + \frac{0.64952}{n}$

Tables II and III are given for convenience, being derived from the above.

TABLE II.—SPECIAL STRAIGHT FIXTURE PIPE THREADS.
MALE THREADS.

DIMENSIONS IN INCHES

Pipe size	Threads per inch	Maximum diameter			Minimum diameter		Tolerance	Minimum length of thread
		Outside	Pitch basic	Root	Outside	Pitch	Pitch diameter	
1/8	27	0.3989	0.3748	0.3507	0.3868	0.3708	0.004	0.2638
1/4	18	0.5260	0.4899	0.4538	0.5089	0.4849	0.005	0.4018
3/8	18	0.6631	0.6270	0.5909	0.6460	0.6220	0.005	0.4078
1/2	14	0.8248	0.7784	0.7320	0.8033	0.7724	0.006	0.5337
3/4	14	1.0353	0.9889	0.9425	1.0138	0.9829	0.006	0.5457
1	11 1/2	1.2951	1.2386	1.1821	1.2692	1.2316	0.007	0.6828

TABLE III.—SPECIAL STRAIGHT FIXTURE PIPE THREADS.

FEMALE THREADS

DIMENSIONS IN INCHES.

Pipe size	Threads per inch	Maximum diameter		Minimum diameter			Tolerance	Minimum length of thread
		Pitch	Root	Outside	Pitch basic	Root	Pitch diameter	
⅛	27	0.3788	0.3628	0.3989	0.3748	0.3507	0.004	0.2638
¼	18	0.4949	0.4709	0.5260	0.4899	0.4538	0.005	0.4018
⅜	18	0.6320	0.6080	0.6631	0.6270	0.5909	0.005	0.4078
½	14	0.7844	0.7535	0.8248	0.7784	0.7320	0.006	0.5337
¾	14	0.9949	0.9640	1.0353	1.9889	0.9425	0.006	0.5457
1	11½	1.2456	1.2080	1.2951	1.2386	1.1821	0.007	0.6828

Electric Caps.

14. While the sizes given in Tables II and III should be satisfactory on gas burners, fixture nipples, insulating joints, hickeys and the general run of similar fittings for all female threads and for male threads, when straight threads are necessary, they are not safely usable on electric socket caps, as the fit with the nipple or coupling should be sufficiently loose to permit the cap to be easily screwed down to the shoulder without strain.

15. *Male Electric Socket Caps.*—Pipe couplings into which these caps are screwed, are commercially made with a tolerance of one thread each side of the notch on the American Briggs Standard, as adopted by the Committee of Manufacturers on Standardization of Fittings and Valves. Therefore, it is desirable that the maximum be less than *basic* size by 0.001 inch more than one thread. Referring to Fig. 2,

$$\text{Maximum pitch diameter} = B - (H + 0.001).$$

As the tolerances, as well as the relative root and outside diameters, will be as in Par. 6 to 9 and 13, Table IV is derived for convenience; in this the minimum lengths of thread recommended also are shown.

TABLE IV.—SPECIAL STRAIGHT ELECTRIC FIXTURE THREADS. MALE ELECTRIC CAPS, ETC.

DIMENSIONS IN INCHES.

Pipe size	Threads per inch	Maximum diameter			Minimum diameter		Tolerance	Minimum length of thread
		Outside	Pitch	Root	Outside	Pitch	Pitch diameter	
⅛	27	0.3956	0.3715	0.3474	0.3835	0.3675	0.004	0.250
¼	18	0.5215	0.4854	0.4493	0.5044	0.4804	0.005	0.281
⅜	18	0.6586	0.6225	0.5864	0.6415	0.6175	0.005	0.281
½	14	0.8193	0.7729	0.7265	0.7978	0.7669	0.006	0.375
¾	14	1.0298	0.9834	0.9370	1.0083	0.9774	0.006	0.375
1	11½	1.2887	1.2322	1.1757	1.2628	1.2252	0.007	0.500

16. *Female Electric Socket Caps.*—The ⅛-inch size is most largely used, and owing to the oversize fixture nipples now in use, an arbitrary minimum pitch diameter of 0.3790 inch is recommended. This size will not be too loose on standard nipples. For sizes above ⅛ inch, a minimum pitch diameter one thread larger than *basic* is taken:

$$\text{Minimum pitch diameter} = B + H.$$

17. Tolerances on all sizes should be same as established in Par. 6 to 9 and 13, and the root and outside diameters should be proportional. Table V is derived for convenience, in which the minimum length of thread recommended is shown.

TABLE V.—SPECIAL STRAIGHT ELECTRIC FIXTURE THREADS. FEMALE ELECTRIC CAPS, ETC.

DIMENSIONS IN INCHES

Pipe size	Threads per inch	Maximum diameter		Minimum diameter			Tolerance	Minimum length of thread
		Pitch	Root	Outside	Pitch	Root	Pitch diameter	
⅛	27	0.3830	0.3670	0.4031	0.3790	0.3549	0.004	0.2638
¼	18	0.4984	0.4744	0.5295	0.4934	0.4573	0.005	0.4018
⅜	18	0.6355	0.6115	0.6666	0.6305	0.5944	0.005	0.4078
½	14	0.7889	0.7580	0.8293	0.7829	0.7365	0.006	0.4370
¾	14	0.9994	0.9685	1.0398	0.9934	0.9470	0.006	0.4370
1	11½	1.2510	1.2134	1.3005	1.2440	1.1875	0.007	0.5000

18. Your committee, therefore, recommends the use of *straight pipe threads* and *locknut threads* as adopted by the Committee of Manufacturers on Standardization of Fittings and Valves, and as described in Par. 4 to 12 of this report, and further recommends the use of the special straight threads described in Par. 8 to 13 and thereafter in this report. It further recommends that there be deposited with the Bureau of Standards, Washington, D. C., master gauges, the expense of such gauges to be borne by the manufacturers.

19. The Straight Pipe Threads recommended by the Committee of Manufacturers on Standardization of Fittings and Valves, are known by that name. Your committee, therefore, recommends the use of this name for these standards only, and that the special standards above described be known as Special Straight Fixture Pipe Threads and Special Straight Electric Fixture Threads respectively.

Exhibit "B."

Tentative Specification for Flexible Gas Tubing.

Transverse Strength:

Tubing to be capable of withstanding, without crushing, a load of 100 pounds per running inch.

Tensile Strength:

Tubing to be capable of withstanding, without rupturing, a steady load of 75 pounds.

Torsional Strength:

Tubing, when subjected to a twisting moment, acting either clockwise or counter-clockwise, to be capable of withstanding, without rupturing, an angular deflection of 180 degrees per lineal foot.

Dimensions:

The inside diameter of tubing (diameter of gas-way) to be $^3/_{16}$ inch, $^5/_{16}$ inch, $3/8$ inch, or other sizes, as need may develop. The outside diameter to be no larger than necessary to comply

with the requirements of this specification. Maximum outside overall diameter to be $^{7}/_{16}$ inch for the $^{3}/_{16}$-inch tubing, $^{9}/_{16}$ inch for the $^{5}/_{16}$-inch tubing, and $\frac{5}{8}$ inch for the $\frac{3}{8}$-inch tubing. A variation of $^{1}/_{32}$ inch from these dimensions is allowable.

Flexibility:

A one-foot length of $^{3}/_{16}$-inch, $^{5}/_{16}$-inch or $\frac{3}{8}$-inch tubing, when held horizontally at one end, should have a drop of at least 45 degrees, this angle being measured between the horizontal axis of the point of support and a line connecting the point of support with the free end of the tubing.

Bending:

Either $^{3}/_{16}$ inch or $^{5}/_{16}$ inch tubing to be capable of withstanding, without rupture, the strain produced by bending the tubing into a circle of 2 inches mean diameter. Three-eighth inch tubing to be capable of withstanding, without rupture, the strain produced by bending the tubing into a circle of 3 inches mean diameter.

Pressure Loss:

A 6-foot length of $^{3}/_{16}$-inch tubing, equipped with the specified rubber slip ends, or with the specified metal ends, secured in the specified manner, shall not show a pressure loss in excess of four-tenths ($^{4}/_{10}$) inches of water, when passing gas of 0.6 specific gravity at the rate of 5 cubic feet per hour.

Similarly, a 6-foot length of $^{5}/_{16}$-inch tubing shall not show a pressure loss in excess of one and one-tenth (1.1) inches of water, when passing gas at the rate of 30 cubic feet per hour.

Similarly, a 6-foot length of $\frac{3}{8}$-inch tubing shall not show a pressure loss in excess of three-tenths ($^{3}/_{10}$) inch of water, when passing gas at the rate of 30 cubic feet per hour.

Tightness:

A 6-foot length of tubing, when connected up to the outlet of a gas meter graduated to read to $^{1}/_{100}$ of a cubic foot, and subjected to a gas pressure of at least six (6) inches of water, shall show no leakage over a 15-minute period.

Construction:

Tubing to consist of the following component parts which are given in their order from the inside to the outside of the tubing:

(A) Rubber packed metallic core.
(B) Waxed paper wrapping.
(C) Braided cotton fabric sheath, impregnated and coated on one side only with a gas-proof and gas-tight compound.
(D) Waxed paper wrapping.
(E) Braided cotton covering.
(F) Silk, silkaline or cotton-finish covering.

(A)—Metallic core to be formed of one unbroken strip of metal, wound spirally with an interlocking seam and made gas-tight by a continuous rubber thread-like gasket.

(B) and (D)—Waxed paper to be of such grade and width and so wound that it will form a covering impervious to moisture when the tubing is subjected to specified bending tests.

(C)—Woven cotton fabric to be of such a character as to absorb and hold securely the specified quantity of the compound. The compound to be of such composition that it will not soften to a sufficient extent to ooze through the waxed paper wrapping when the tubing is subjected for a period of 48 hours to an atmosphere of 100° F. and 100 per cent. humidity; and that, when subjected for 48 hours to an atmosphere at 0° F., it shall not crack or lose its gas-tight property when subjected to the tests for bending. A sufficient quantity of the compound to be used to ensure a thickness of the impregnated and coated cotton fabric of not less than $^{1}/_{32}$ inch or more than $^{3}/_{64}$ inch.

(E)—Cotton covering, if dyed, to be dyed with *fast* color, preferably to match color of finish covering or of some neutral tint, and of such a texture to protect properly the paper from abrasion.

(F)—Finish covering to be furnished as ordered; to be dyed with *fast* color.

End Connections:

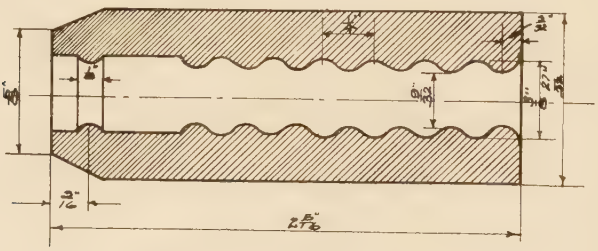
Metal end connections to be attached to the tubing as described in Figs. 1, 2, and 3, Exhibit "D."

Exhibit "C."

Proposed Design for Standard Hose End Nozzle and Standard Rubber Hose End.

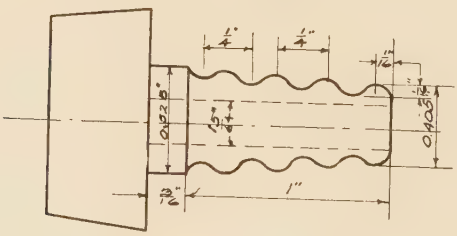
Committee on Standardization of Gas Appliance Specifications, National Commercial Gas Association.

Fig. 1.



Design of Rubber Hose End

Fig. 2.



Design of Hose End Nozzle

Note—The combination of rubber end and hose end nozzle shown above, and recommended for adoption, represents an increase in pull necessary to dislodge the rubber end from its connection of 56 per cent. over average existing designs.

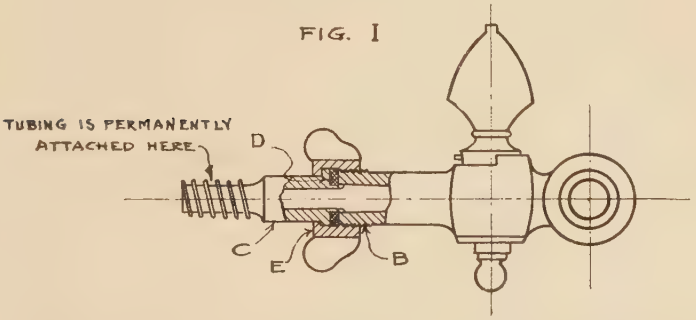
The matter of chemical composition of the rubber ends is now the subject of discussion between the committee of the N. C. G. A., your committee and the National Bureau of Standards, Washington, D. C. We believe the matter will be settled definitely in time for inclusion in next year's report.

The method of attaching proposed standard rubber ends to standard flexible tubing is being designed and tested. It was hoped to complete the design in time for inclusion in this exhibit.

Exhibit "D."

Safety Union Joint for Gas Tubing.

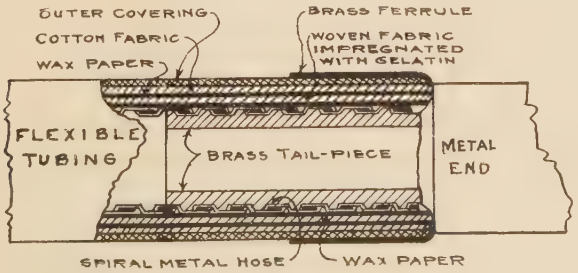
FIG. I



The nozzle end (B) of an independent cock is threaded, and its face finished, so as to form a seat for a washer joint. The washer is attached to a metal end (C). A wing nut (E), which slides on the metal end (C) and which is tightened by the fingers, serves to secure the metal end to the independent cock, and to make the joint tight. The tail piece of the metal end (C) is spirally corrugated for attachment to the standard tubing described in the report, as shown in detail in Fig. 2.

Method of Attaching Ends to Standard Tubing.

FIG. 2



CONNECTION TO INDEPENDENT COCK

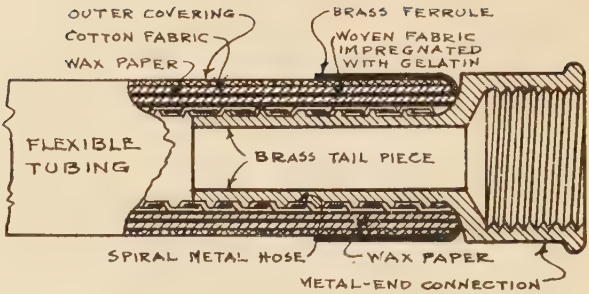


FIG. 3

CONNECTION TO APPLIANCE

The tail piece of the metal-end is corrugated to fit the spirals of the metal base of the tubing. The tail-piece is coated with glue and screwed into the tubing. The glue hardens and serves to ensure gas-tightness. Before the metal-end is screwed in, a brass ferrule is slipped over the end of the tubing, and is held in place by the shoulder on the metal-end after it is screwed home. The ferrule imparts neatness to the connection.

Exhibit E.—Radiant Heat From Blue and Luminous Flame Heaters.

(Test Made at the Appliance Laboratory of The United Gas Improvement Co., Philadelphia, Pa.)

The object of this test was to compare the efficiencies of various types of heaters, considering only the radiant heat. Neither heat of convection nor heat of conduction were measured, nor was any examination made of the quantity and composition of the products of combustion.

The heaters used for this test include heaters of foreign manufacture, as well as heaters of domestic manufacture.

No. 1 is a domestic-make, portable heater, containing three radiating elements consisting of semi-cylindrical, vertical, ground glass shells, heated by a blue flame burner beneath.

No. 2 is a foreign-make, blue flame, portable heater, containing six radiating elements in the shape of coarse fabric mantles.

No. 3 is a domestic-make, fireplace heater whose radiating element consists of a refractory slab heated by blast burners.

No. 4 is a foreign-make, fireplace heater, containing radiating elements consisting of vertical ceramic grids.

No. 5 is a domestic-make, portable, reflector heater with yellow flame burners placed near the bottom of the heater.

No. 6 is a domestic-make, portable heater whose radiating element consists of an asbestos back heated by blue flame burners under atmospheric pressure.

No. 7 is a domestic-make, fireplace heater whose radiating element consists of two Vitreosil cylinders heated by blue flame burners.

No. 8 is a domestic-make, portable heater whose radiating elements consist of three vertical, perforated refractory cylinders heated by blue flame burners.

No. 9 is a foreign-make, fireplace heater whose radiating element consists of a net work of refractory substance heated by blue flame burners.

No. 10 is a domestic-make, cylindrical, portable heater whose radiating element consists of a sheet metal drum heated by yellow flame burners.

Number	Make	Type	Radiant efficiency		
			Front	Back	Total
1	Domestic	Portable Heater	29.2	17.9	23.5
2	Foreign	" "	35.8	25.9	30.8
3	Domestic	Fireplace "	55.7	5.7	30.5
4	Foreign	" "	64.7	12.7	38.7
5	Domestic	Portable "	14.7	6.7	10.7
6	"	" "	41.8	12.6	27.2
7	"	Fireplace "	33.8	23.6	28.7
8	"	Portable "	60.5	19.3	39.9
9	Foreign	Fireplace "	67.7	18.5	43.1
10	Domestic	Portable "	20.7	21.2	20.9

W. J. Serrill, *Chairman*,
G. S. Barrows,
W. J. Clark,
H. C. Fritz,
D. E. Keppelmann,
E. B. Myers,
J. A. Norcross,
W. H. Pettes,
G. D. Roper.

PHOTOGRAPH No. 1.—Exhibit E.

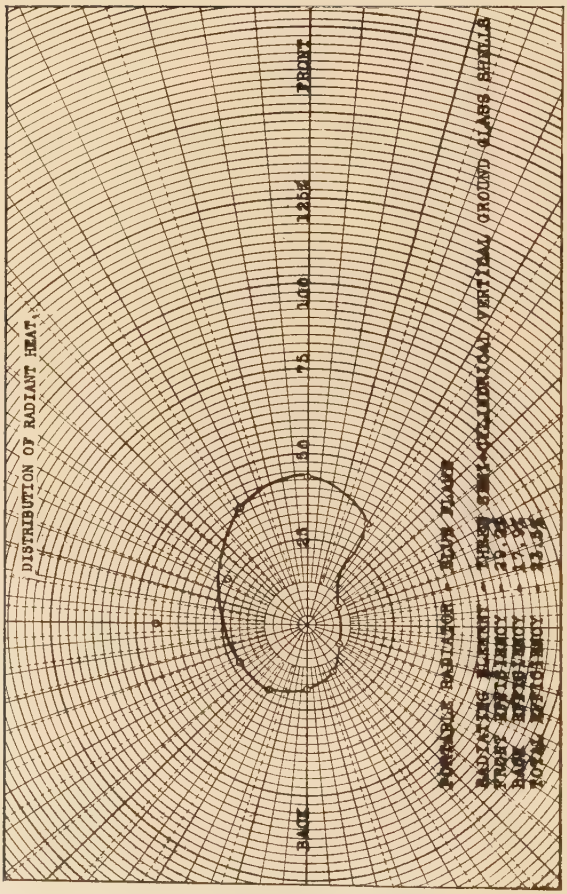


PLATE No. 1.- Exhibit E.

PHOTOGRAPH No. 2.—Exhibit E

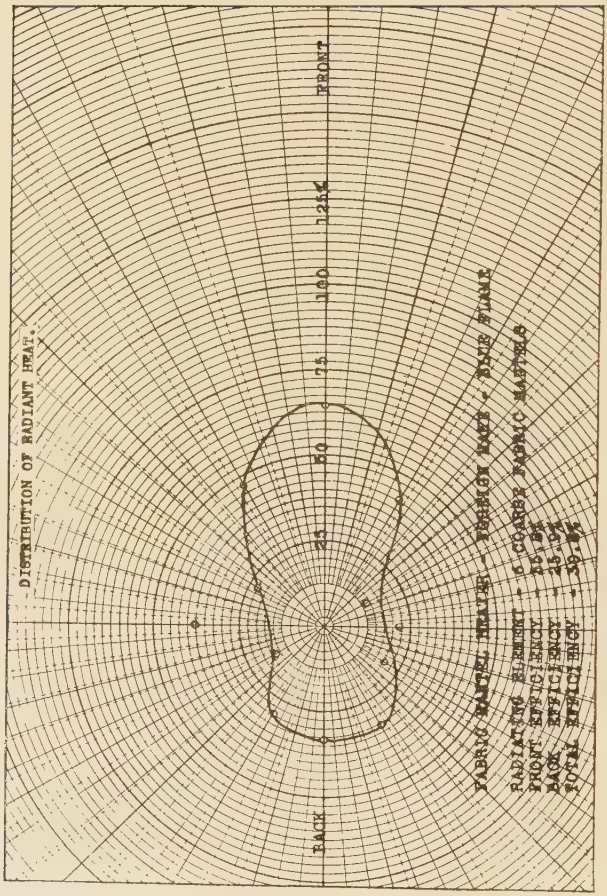


PLATE NO. 2.—Exhibit E.

PHOTOGRAPH No. 3.—Exhibit E.

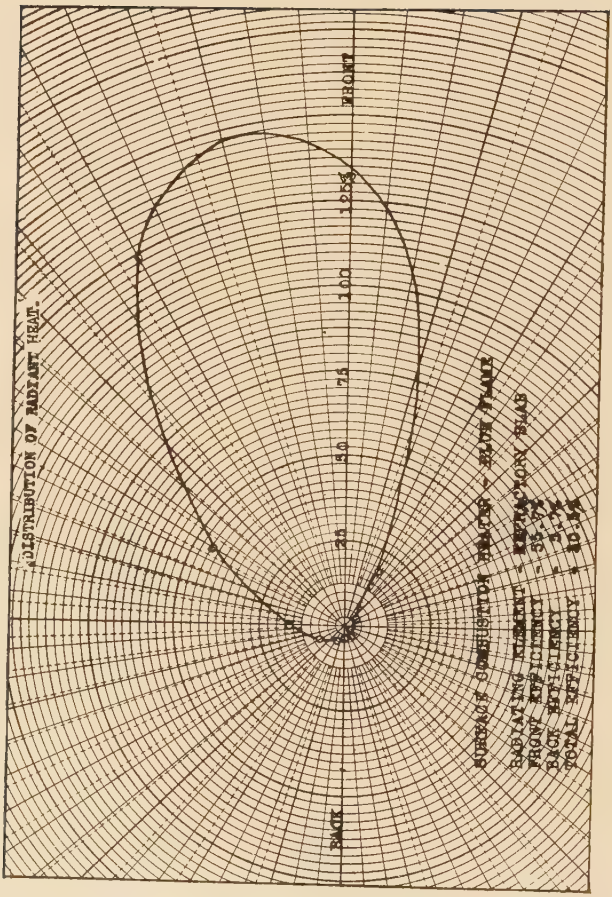
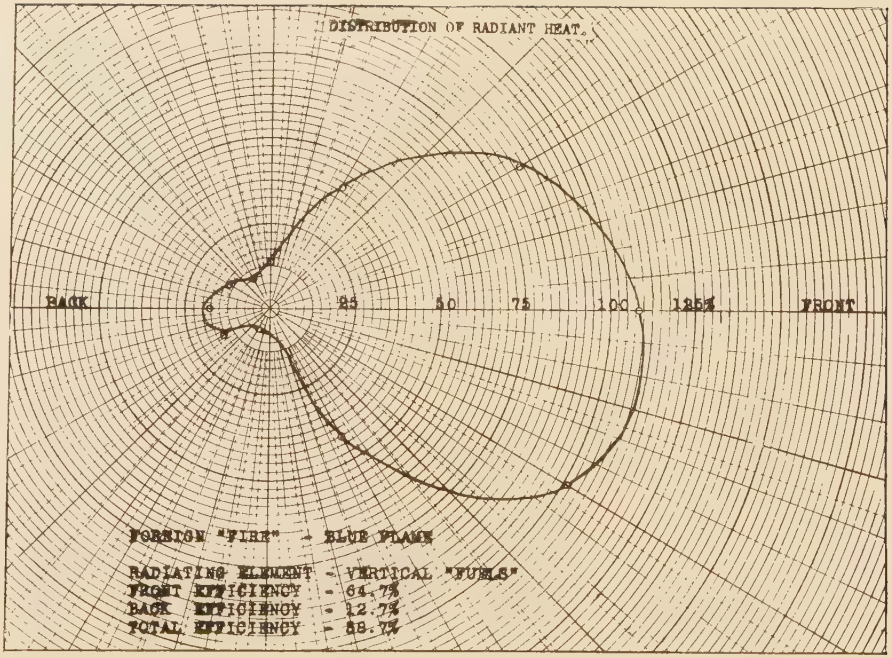


PLATE No. 3.—Exhibit E.

PHOTOGRAPH No 4 — Exhibit E.



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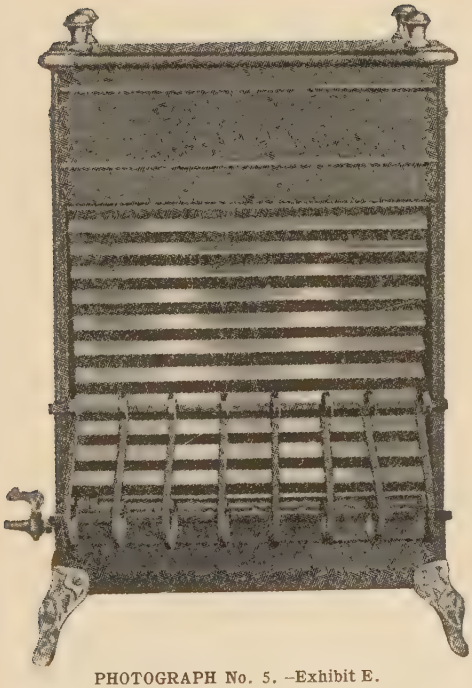

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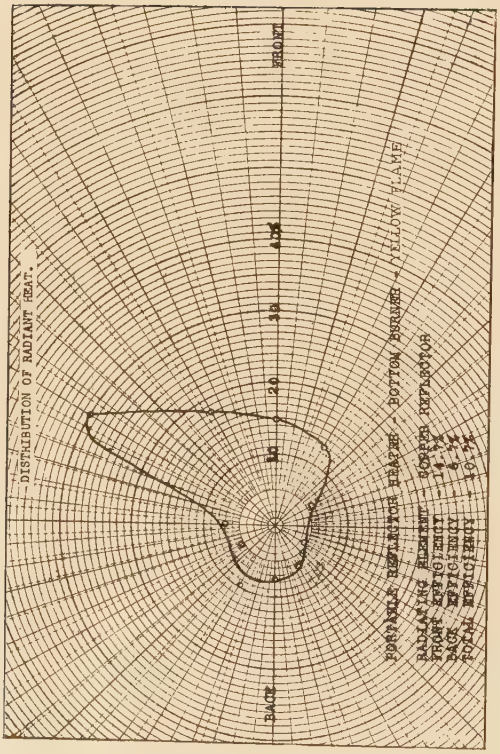

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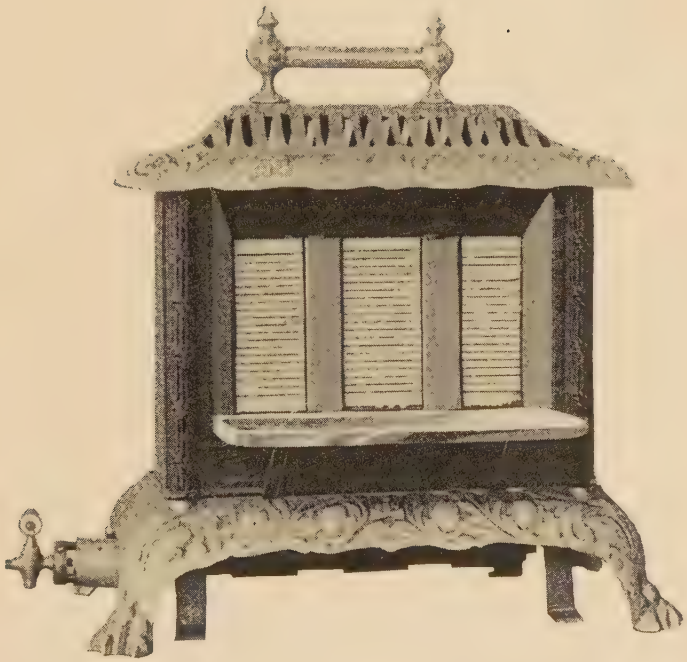

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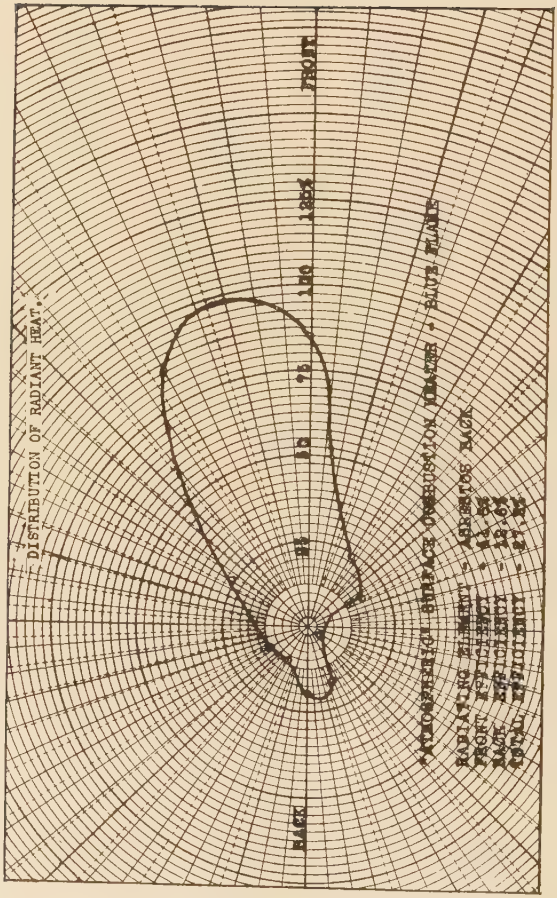


PLATE No. 6.—Exhibit E.

PHOTOGRAPH No. 7.—Exhibit E.

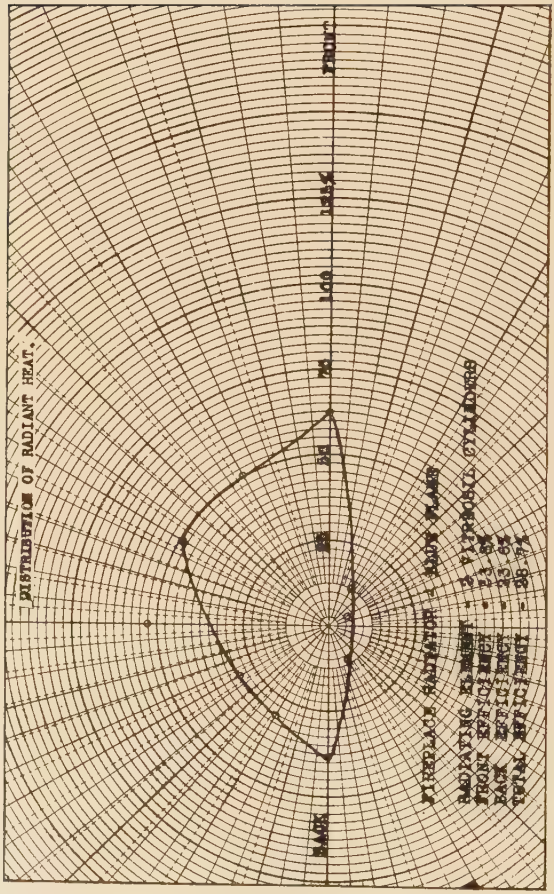
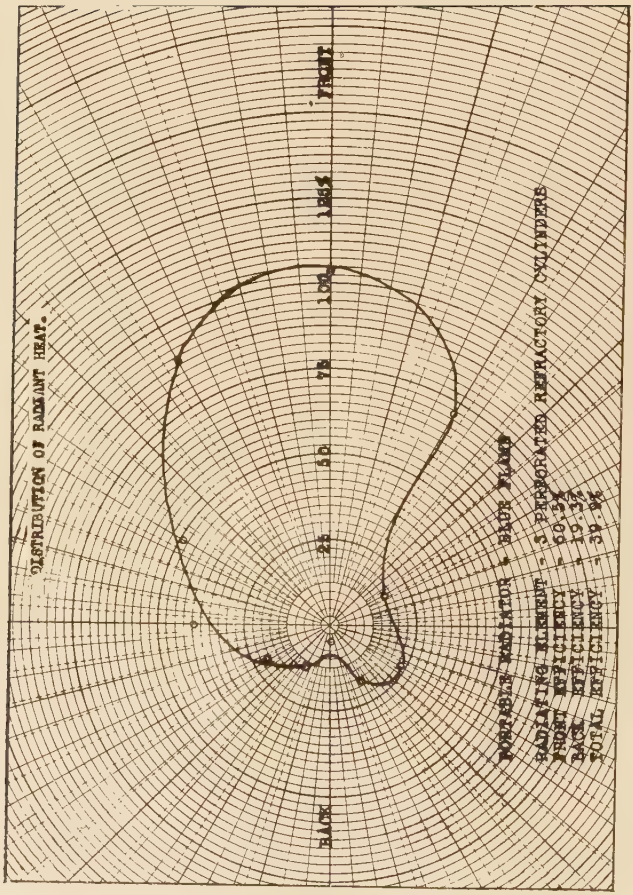


PLATE No. 7.—Exhibit E.

PHOTOGRAPH No. 8.—Exhibit E.



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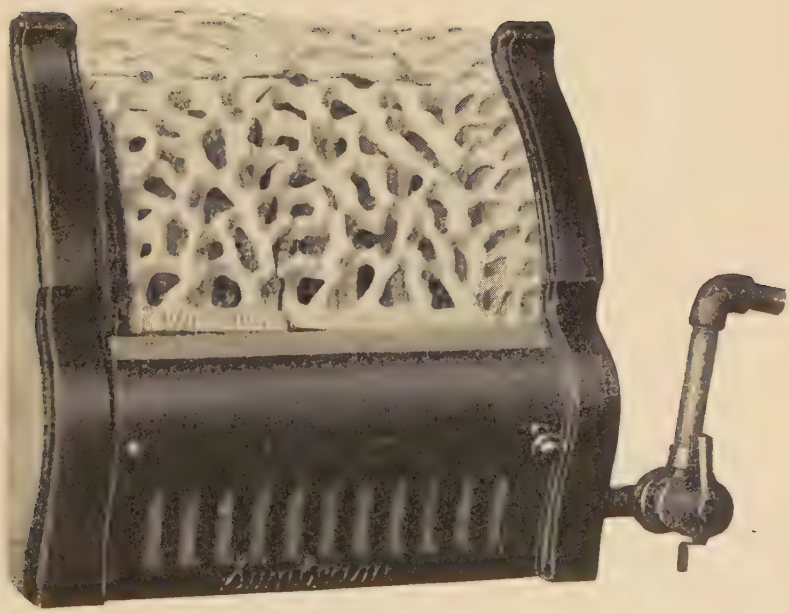


PHOTOGRAPH No. 9.—Exhibit E.

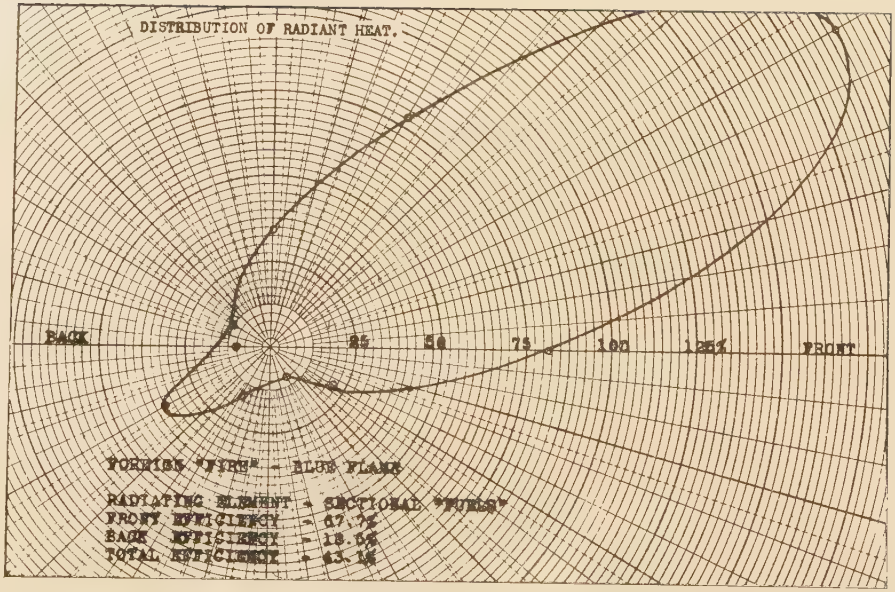


PLATE No. 9.—Exhibit E.

PHOTOGRAPH No. 10.—Exhibit E.

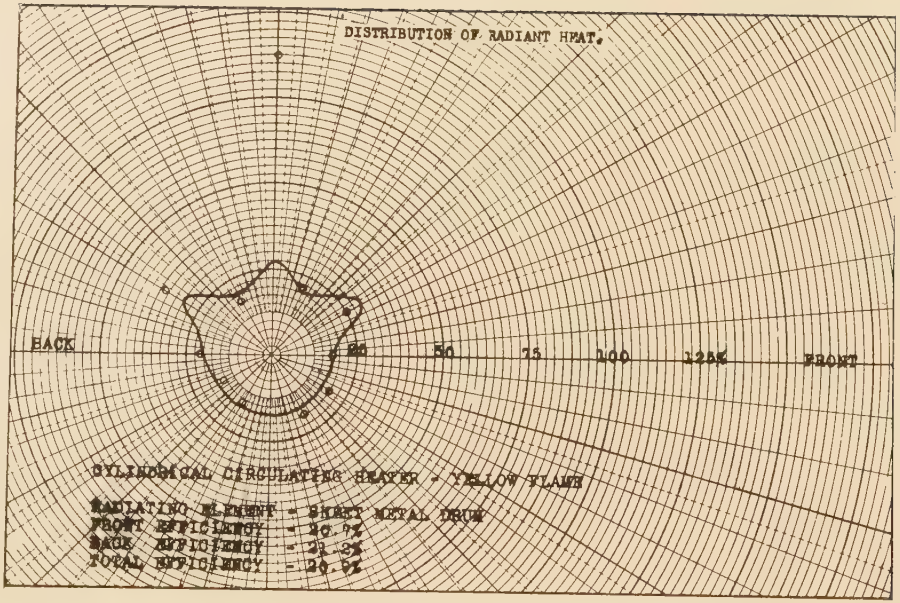


PLATE No. 10.—Exhibit E.

Mr. W. J. Serrill: This paper is printed, and I will not attempt to read it through. It opens with advice to gas companies to confine their use to gas ranges that are made in accordance with the specifications which the American Gas Institute adopted 2 years ago.

The second paragraph deals with fixture specifications. You may remember that 2 or 3 years ago we adopted a fixture specification. At that time there was one section of it that was incomplete. There has been nothing done toward a standardization of the straight threads that are used in the makeup of fixtures. That matter was taken up by a committee of the American Society of Mechanical Engineers, and in this report in an exhibit is reprinted now the complete fixture specification including the findings of the American Society of Mechanical Engineers. Their committee's report was adopted at their meeting during this past year.

Now, both the gas range specification as well as the fixture specification I think ought to be published by the Institute in pamphlet form for general distribution. And the suggestion is made here that since the National Commercial Gas Association likewise adopted these two standards, that a combined pamphlet be gotten out under the auspices of both associations.

The second subject is flexible tubes and connections. In the view of our committee there is not any more important subject than this. Our market, as you know, is flooded with cheap tubing, and I do not think there is any way in which the gas industry gets in worse odor with the underwriters and with the consumers than on the question of tubing.

We give on page 957 a list of the various requirements that have to be met. In Exhibit B is a tentative specification of a tubing which we believe is going to solve this problem. There has not been sufficient time to try it out to a great enough extent to determine that definitely, and the thought is that by this time next year we hope we can come to the Institute with a proposition to adopt a standard specification for gas tubing.

This tubing is not a rubber tubing, as those of you who

have read the paper will notice, but a tubing built up with a spiral metal base. And we believe it is going to retain its flexibility and be more uniform and safe than most of the tubings now on the market.

The question of the ends of tubing is a different matter, that is, the mode of connection of the tubing to the appliance end of the piping. That is a different question from the tubing itself. Our committee has for years, as you may know, taken a stand against the slip end. We believe that ultimately the slip end must be done away with. It will take many years to do that even if an acceptable substitute were at hand. And we therefore in this report have endorsed the work of the committee of the National Commercial Gas Association in standardizing slip end tubing. And in an exhibit here we give a picture of the standardized slip end.

Mr. Fogg of New York, who is chairman of their committee, has made a great many experiments, and he has obtained an end—it is not only the design of the rubber end but it is the design of the metal piece that goes on the appliance. He has got those two so combined that it is a very difficult matter to pull them off accidentally after it is once on, and yet it is not a very easy matter by working back and forth to get it on and off. Their work on that subject is not entirely completed, and our committee is aiding them now, and has been in conference with the manufacturers of rubber ends, and with the Bureau of Standards in Washington to try to get a standard specification of the makeup of the contents of the rubber end of the slip joint. But as I say, we believe that ultimately the slip joint should be done away with, that some desirable substitute that cannot possibly pull apart, should be found.

There is presented here in the report as an exhibit a drawing of what we hope is going to prove a desirable substitute. It is being tried out on quite a large scale. In addition to being tried experimentally in our laboratory it is being distributed to consumers, and quite a number of these joints have been sent to members of the committee all over the country for trial in other situations and to other gas companies.

It is a joint that is, as you see, worked is like a union, and can be made hand-tight by the fingers. And the appliance with the tube attached can be carried off to another room and hitched onto another connection that is attached permanently to the wall just in the way that a slip joint is moved. And yet it really is a metal-to-metal connection, and there is no reason that I can see why with that connection and with the standard tubing which we here advise, and perhaps next year recommend why we should object to having the gas continuously in that tubing. With the slip end, I think we should insist on a cock, at the wall so that the gas could be turned off of the tubing, or must be turned off of the tubing when the appliance is not in use. But with this new tubing and this new connection I think it is completely safe. It is a metal-to-metal connection throughout. Practically it is about as safe as any of the rest of the house piping. I see no reason why the cock should not be at the appliance and the gas pressure continuously in the tubing.

The section of this report dealing with industrial appliances I read this morning at the time that subject was up.

The section dealing with room heating has likewise been referred to by Mr. Myers when that subject was discussed.

The question of tests of cooking appliances—you may remember, was discussed yesterday. The committee has been doing a good deal of work on that subject and hopes next year to be able to give more information.

The Chairman: The report is before you for discussion. I would like particularly to have you bear in mind Mr. Serrill's recommendations that the specifications for gas fixtures and gas fixture cocks be printed by the Institute in pamphlet form, and in doing so have the work done in conjunction and co-operation with the National Commercial Gas Association. This report represents a vast amount of work, and properly to discuss it one must study it.

I will appoint a committee a little later to prepare a resolution to be presented to the Institute. I think would be the better way of handling that.

We have one short report that we would like to finish before we adjourn, the report of the Committee on Gas Housepiping. Mr. Vincent is the Chairman.

REPORT OF COMMITTEE ON GAS HOUSEPIPING.

Your Committee on Gas Housepiping begs to present the following report.

In the preparation of the rules and specifications in this report your Committee has endeavored to formulate the rules so that they would be applicable, with very minor changes, to any situation.

It is intended that these rules are for fitters and plumbers, and it will be noted that they are so formulated that a final decision in any doubtful case rests with the gas company.

The notes attached at the end of the report are intended for an explanation of the particular rules to which they refer. It did not seem advisable to include these explanations in the report proper.

The report as submitted was largely prepared by Mr. C. E. Reinicker, the former Chairman. Only minor changes have been made in the original draft as prepared by him. Your Committee wishes to take this opportunity of expressing their appreciation of his work.

Respectfully submitted,

COMMITTEE ON GAS HOUSEPIPING.

H. B. ANDERSEN,
J. J. BURNS,
F. C. MILLARD,
B. F. PELTON,
A. E. TURNER,
G. I. VINCENT, *Chairman.*

This is a tentative specification only and not indorsed by the American Gas Institute.

General Specifications.

Smallest Size of Pipe Allowed.—No pipe smaller than ⅛ inch shall be used.

Pipe and Fittings.—All pipe used shall be standard, full weight, of the best quality wrought iron or steel, and free from defect. All fittings (except stop-cocks or valves) shall be of best quality malleable iron. Galvanized fittings will be permitted and fittings galvanized on exterior only are preferred.

Defective Material.—Pipe or fittings which are defective or have been repaired with cement, lead, or by any other method, including caulking, shall not be used. Repairs made by approved autogenous welding will be permitted.

Materials not Permitted.—Unions must not be used on piping which is to be concealed or which may subsequently be concealed. For concealed work long screws or right and left couplings must be used.

Mr. E. S. Umstead (Washington, D. C.): (Written discussion.) By construction long screws are better adapted for repair work than right and left couplings. The latter offer a strain on piping which should be avoided. Would suggest the adoption of the long screw.

Obstructions in Pipe.—All piping must be free from burrs or other obstructions.

Jointing Pipe.—In making up the joints of gas piping, an approved jointing compound shall be used, and this shall be applied sparingly to the male thread of the pipe or fitting and not to the female thread of the fitting. The use of gas fitter's cement is prohibited as a pipe jointing compound.

Threading Pipe.—Pipe must be threaded with clean cut threads. The following table gives the best practice as to length of the thread cut.

Size of pipe	Approximate length of threaded portion	Approximate number of threads to be cut	Minimum number of threads to be used in making up	Number of threads per inch
3/8″	9/16	10.125	7	18
1/2″	5/8	8.75	7	14
3/4″	11/16	9.62	7	14
1″	3/4	8.63	7	11-1/2
1 1/4″	13/16	9.34	8	11-1/2
1 1/2″	7/8	10.06	8	11-1/2
2″	1	11.50	9	11-1/2
2 1/2″	1 1/8	9.00	9	8
3″	1 1/4	10.00	9	8
4″	1 1/2	12.00	10	8

Painting or Coating Pipe.—Pipe must not be painted or coated until after the first inspection.

Grading of Pipe.—Piping must be free from traps, and must grade to risers or toward an approved type of drip especially provided for removing condensation. (Note 1.)

Breaking Sizes.—When an extension is to be made, the pipe must always be broken at a point where the full size can be maintained. No extension shall be made from a pipe of smaller size.

Branching of Pipe.—All branches must be taken from sides or top of running lines and not from the bottom.

Bending Pipe.—Bending pipe to form outlets, or for other purposes when approved by the gas company will be permitted. In bending pipe care must be taken that it does not kink. Pipe excessively flattened or bent to less than the radii given below will not be permitted.

Size of pipe inches	Minimum radius of bend inches
3/8	3
1/2	4
3/4	5
1	6
1 1/4	8
1 1/2	10
2	14

Gas Engine.—The gas supply for a gas engine must be run independently from the engine to the proposed location of the

meter. A suitable cut-off valve must be provided at the engine and an approved pressure equalizer, or other device acceptable to the gas company must be used. Before any work of installing a gas engine or piping for one is done, consultation with the gas company is advised.

Building Services.

Size of Building Services.—The gas company must be consulted as to the size of a building service. (Note 2.)

Services.—When risers are located in the rear of a basement, or in a room provided for that purpose, or on the various floors, the building service must be brought to within 3 feet of the proposed location of the street service.

Building Service Header.—When it is necessary to set more than two meters together, a building service header must be supplied with an opening for each meter, which openings must not be less than 18 inches apart.

Grading of Building Service.—A building service must be graded to the street, and in any horizontal run the tee left turned up, so that any condensation forming in the pipe will run to the street and not to the meter.

Wrapping Building Service.—A building service exposed to freezing temperatures must be properly protected in a manner satisfactory to the gas company. If insulating covering is used it must be incombustible. (Note 3.)

Opening in Building Service.—The opening in a building service must be on the left-hand side of the riser which it is to supply, and not less than 18 inches from it.

Riser Location, Etc.

Location of Meter.—The gas company reserves the right to determine in all cases the location of the meter.

Prohibited Locations for Riser.—A riser must not end in any place where the gas company's meter will be set in closets or small rooms unless ventilation satisfactory to the gas company is provided or at any place where the meter will be exposed to frost, dampness, extremes of temperature or be liable to injury from any cause. (Note 4.)

Piping for Laundry Room.—In a building where appliances such as laundry stoves, driers, etc., are installed for the joint use of tenants, a pipe from such tenant's meter may be run to the laundry room and a header provided on the wall adjacent to the appliance. Each riser must be equipped with a lock cock. A metal tag with the proper designation marked thereon must be fastened to each cock. One outlet for a light in laundry may be taken from the end of the laundry header.

Alignment of Risers.—Where meters are to be located at one point, the risers must not be scattered, but must drop in alignment to the basement at a convenient point, with a clear space of not less than 3 inches between any two of them, and must be extended horizontally to within 3 feet of the proposed location of the meters.

Distance Below Ceiling.—A riser must extend not more than 3 inches below a ceiling and not less than 1½ inches below a finished ceiling, and not less than 2 inches below an unfinished one.

Riser Termination, Separate Apartments.—When risers end in separate apartments, each one must be extended to within 18 inches of the outlet on the building service and to the right of it, facing the riser.

Riser Termination, Single One in Building.—Where there is only one riser in a building it must be brought to a point within 3 feet, measured in a horizontal direction, of the proposed head of the service.

Riser Obstructions.—Risers must not end in any place where beams, girders, or heater pipes, which may be installed subsequently, will interfere with making connections to meter.

Tee on End of Riser.—A tee with a full sized opening, looking down, must be placed at the lower end of every vertical riser. The opening must be closed by a short nipple and cap. (Note 5.)

Piping on Outside Wall, Cold Climates.—Where climatic conditions may be severe a riser must not be run on or within

3 feet of an outside wall unless there is no inside partition available, in which case the pipe must be run near the chimney breast of the exposed wall. Where it is impossible to run a riser except at a location where there is a possibility of exposure to low temperature, the gas company must be consulted before proceeding with the work. (Note 6.)

Mr. E. S. Umstead (Washington, D. C.): (Written discussion.) Would suggest exposing pipe where it cannot be protected against extreme weather, as a positive cure. I think the point about the chimney heat is not well taken and leaves room for escape. There are in many cases several chimneys and not all of them in use even in extreme weather. We may also get to the point of heating the rooms by gas with space heaters (portable heaters) which would leave the supply of this gas in an unprotected place.

Outlets for Light and Fuel.

Capping Outlets.—All outlets must be securely closed with threaded iron plugs or caps until the fixtures or appliances are installed.

Outlets for Side Brackets.—Outlets for side brackets may be either square bends or long drop ells. The use of nipples is permitted but the drop must be firmly fastened within 2 inches of the outlet fitting so that the pipe will not spring if the nipple is screwed out. (Note 7.)

Outlets, Distance From Wall.—Outlets shall project not more than $\frac{7}{8}$ inch or less than $\frac{5}{8}$ inch from the finished wall and must be firmly secured at right angles to the wall.

Drops From Branch Lines.—Drops from branch lines must be offset with an ell or bent pipe, and drops must drop square. Nipples are permitted, but the run and nipple must be so secured that if the nipple is subsequently backed out it may be safely screwed back into the fitting.

Drops.—Drop outlets must project from $1\frac{1}{2}$ inches to 2 inches below an unfinished ceiling and not less than $\frac{3}{4}$ inch or more than 1 inch below a finished ceiling.

Outlets for Illumination.—Outlets for illumination must not be placed in any location where good practice forbids, and the gas company reserves the right to reject any piping where the outlets are placed in unsatisfactory locations. (Note 8.)

Outlet for Fuel.—If the pipe has been run under the floor, the outlet for fuel must be located 3 inches above the floor and project 2 inches clear of the baseboard. If, in the kitchen, the pipe has been run overhead and down, the outlet must be located 3 feet from the floor and project 2 inches clear of the finished wall. If, in other rooms the pipe has been run overhead and down, the outlet must be located 3 inches above the floor and project 2 inches clear of the baseboard.

Outlet for Mantel.—An outlet for a mantel or fireplace must project 1½ inches above the finished bottom of the fireplace and be located 6 inches from the back and left-hand side of the fireplace.

Fastening Pipe.

Fastening Pipe, Building of Ordinary Construction.—All piping must be securely and rigidly fastened by hooks, metal straps or pipe hangers screwed to the woodwork. When the piping does not run sufficiently close to the woodwork to admit of its being securely fastened, wooden strips, spaced at no greater intervals than are given below, must be provided. These strips must be securely fastened to the woodwork.

⅜ or ½-inch pipe	6 feet
¾ or 1-inch pipe	8 feet
1¼-inch or larger (horizontal)	10 feet
1¼-inch or larger (vertical)	every floor level.

No piping shall be laid to support any weight (except fixtures) or be subjected to any extra strain whatsoever.

Fastening Pipe to Concrete, Tile or Masonry Walk, Partition or Ceiling.—When concrete, tile or masonry are used in the construction of walls, floors, or partitions, the piping, whether concealed or exposed, must be supported and fastened by the use of metal straps, hooks or pipe hangers, securely held to the wall or ceiling by the use of approved expansion bolts or other approved methods. Where wood is permissible,

the piping may be secured by fastening it to wooden plugs driven into the wall. In all cases the same spacing of the fastenings as given in the previous paragraph must be used.

Piping in Connection With Wall, Floors, Etc.

Imbedding Pipe in Concrete or Cement.—When it is necessary that pipe be imbedded in clean concrete or cement so placed that the pipe will be completely and permanently protected thereby, black pipe may be used. If the pipe must be laid in cinder concrete, composition flooring, or is in any way in contact with corrosive building material or is so imbedded that the subsequent contents of the building may produce corrosion, galvanized piping painted with two coats of red lead or approved bituminous compound must be used. Before installing any piping that is to be imbedded, consulation with the gas company is advised.

Encasing Pipe Through Masonry Walls.—Where piping passes through masonry or tile walls, it must be encased and the pipe left resting on the bottom of the casing pipe, with at least ½ inch clearance on top. The opening is to be filled in with mineral wool or other non-combustible compressible material.

Offset in Foundation Wall.—When the end of a riser terminates on the top portion of a foundation wall, making the bottom of the riser inaccessible, the piping must be offset by using a 45° ell, so placed as to bring the end of the riser clear of the wall. (Note 9.)

Running Lines, Ordinary Buildings.—In buildings of ordinary construction (with flooring laid across the joists and with ceiling lathed and plastered below the joists), the horizontal piping must be located just under the floor boards, passing over the joists, which must be notched to a depth of not more than one-fifth of the depth of the joist, and the notching must be not farther from a point of support than one-sixth of the clear span of the joist. (Note 10.)

Piping Under Tile, Etc.—Piping must not be laid under tiled, parquet or mosaic floors when it can be avoided. In

some cases, when beams or girders are to be exposed, the piping may be left exposed below the ceiling, or if desired it may be concealed by a moulding.

Vertical Pipes.—Vertical pipes, if they must be concealed, should, as far as possible, be located in hollow partitions, in preference to being placed in the studding or lathing back of the plaster in masonry walls.

Extension to Existing Piping Concealed.—When installing a concealed extension to existing piping, the location of water pipes, drain pipes, electric conduits, and wiring must be ascertained to avoid damage when the gas pipe is laid through a hollow partition, floor, or other available opening.

Testing and Inspection.

Inspection of Piping.—To insure full compliance with these rules, all piping installed must be inspected and tested by the authority having jurisdiction: First, before the piping is concealed; second, after all work in the building which might disturb the piping has been completed, and before the fixtures or appliances are installed; third, after fixtures have been installed.

New Exposed Fuel Piping.—When any system of piping, installed to supply fuel appliances alone, is to be entirely and permanently exposed, the inspection requirements may be met, if approved by the gas company, by a visual inspection of the quality of the work, and a verification of the size requirements.

Gauge.—The pressure tests must be made with an approved mercury gauge.

Pressure for Testing.—Before the fixtures are installed, the piping must stand a pressure of not less than 3 pounds per square inch, indicated by a column of mercury not less than 6 inches high. The column must show no drop for a minimum of time of 10 minutes. Before the fixtures are installed the air pressure must be up to all caps or plugs. After the fixtures are installed, the system must stand a pressure of at least twice the working pressure, but never less than a column

of water 6 inches high. The column must show no drop for 10 minutes.

New Piping Connected to Old Piping.—A system of new piping that is to be joined to a system of old piping, thus constituting an extension to the latter, requires the regular first inspection before the first connection is made. After this first inspection, and the new piping is connected to the old, the whole enlarged system shall be required to stand a pressure of at least twice the working pressure but never less than a column of water 6 inches high, showing no drop in 10 minutes. This applies whether or not any fixtures are on the old or new system of piping.

Turning on Gas.—Gas will not be turned on until all inspections have been made and the proper certificate has been filed with the gas company, and the gas company reserves the exclusive right to turn on gas to any system of piping, whether new or old in whole or in part.

Use of Acid.—Water, acid or any corrosive liquid must not be used to test or tighten piping, nor shall any material, liquid or otherwise, be applied to the inside or outside of the piping to stop leaks by rusting. A small quantity of ether or oil of peppermint may be introduced into the piping to assist in locating small leaks.

Rules and Tables for Piping.

Equivalent Outlets.—The unit basis for the computation of these tables is taken as a ⅜-inch outlet, through which the flow is assumed to be 10 cubic feet per hour, and all consumptions must be referred to this unit. For example, it is assumed that an ordinary kitchen range will require approximately 60 cubic feet per hour, or six times the amount of gas which a ⅜-inch outlet will pass. On this basis the following table is derived:

Range for flat or residence	6 outlets
Grate or log	3 outlets
Laundry appliances	3 outlets
Water heaters	5 outlets
Arc lamps	2 outlets

Size of Outlets.—If any outlet is larger than ⅜ inch, it must be counted as more than one, according to the following table:

Size of outlet	⅜″	½″	¾″	1″	1¼″	1½″	2″	2½″	3″	4″
Value in outlets	1	2	6	11	20	32	66	115	181	372

TABLE OF SIZES. (Note 11.)

Size of Pipe in Inches.

No. of ⅜″ Outlets	⅜″	½″	¾″	1″	1¼″	1½′	2″	2½″	3″	4″
Length of Pipe in Feet.										
1	20	30								
2		27								
3		12								
4			50							
5			33							
6			24							
7			18	70						
8			13	50						
9				44						
10				35	100					
11				30	90					
12				25	75					
13				21	60	150				
14				18	53	130				
15				16	45	115				
16				14	41	100				
17				12	36	90				
18					32	80				
19					29	73				
20					27	65				
21					24	58				
22					22	53				
23					20	49	200			
24					18	45	190			
25					17	42	175			
30					12	30	120	300		
35						22	90	270		
40						17	70	210		
45						13	55	165	400	
50							45	135	330	
65							27	80	200	
75							20	60	150	600
100								33	80	360
125								22	50	230
150								15	35	160
175									28	120
200									21	90
250									14	59
300										39
350										29
400										22
500										14

Use of Table.—In using the table the following rules must be observed:

1. In determining the sizes of piping, always start at the extremities of the system and work toward the meter.

2. The lengths of piping to be used in each case are the lengths measured from one branch or point of junction to another, disregarding elbows or turns.

3. If the exact number of outlets under consideration cannot be found in the schedule, take the next larger number.

4. For any given number of outlets, no smaller size pipe than the smallest size in the schedule for that number of outlets shall be used.

5. No pipe laid underground shall be less than 1¼ inches.

6. Piping must not be installed to supply gas from a smaller to a larger size pipe, except where enlargements are made to counteract the effect of low temperature or where complying with the preceding rule No. 5. But with the approval of the gas company, fuel appliances may be connected to existing housepiping when the fuel line is larger than the housepiping to which it is connected.

7. When to supply one or more outlets at such a distance from the source of supply that it would be necessary to use sizes of pipe so large that they would interfere with the building structure, the gas company should be consulted before the installation is begun. (Note 12.)

NOTES.

1. The intention of this rule is to prevent stoppages of the piping system primarily by the accumulation of condensation. A line of pipe run level would be satisfactory provided it drained at either end and that there was no possibility of a subsequent settlement of the building which might cause a trap. Specifications for drips are not given, as many gas companies have their own standard. Condensation will not be troublesome in warm climates, but traps in piping may collect rust as well as condensation, and should not be permitted under any conditions.

2. If the rules are rigidly followed, the size of the building service may be excessive where a large number of tenants are to be supplied. It is suggested that the matter be referred to the gas company in all cases, as the character of the building and other factors would affect the size of the proposed riser, and no general rule would apply.
3. The method of protecting the pipe is intentionally left open. For moderately low temperatures incombustible insulating covering would be satisfactory. For very low temperatures an enlargement of the pipe to form an anti-freezer should be used.
4. A list of locations specifically prohibited is omitted, as it is impossible to cover all, and this rule together with the first preceding rule completely covers the subject.
5. It has been suggested that this is only necessary in cold climates. Stoppages at the bottom of risers caused by an accumulation of rust or other compounds of iron have been reported, and good practice demands a clean-out opening at the bottom of a vertical riser under all conditions.
6. It is difficult to make a general rule covering this point, but the rule as written will make it impossible for the fitter to install a riser that will give condensation or freezing trouble.
7. No rule is given covering the question of whether side outlet pipes should rise or drop from the runs. While the former is probably preferable, it requires double piping in one floor apartments and in basement runs.
8. It is impracticable to specify all the prohibited locations for outlets, and the rule was, therefore, made general.
9. This rule is not intended to permit any change in the location of risers covered before.
10. The limits given in this rule are the maximum allowable for safe construction. If special permission should be given to increase the distance of the notch from the point of support, the depth of the notching should be decreased. Consultation with the architect by the gas company should be considered in any unusual case.
11. This table is believed to represent the best practice. The lengths and sizes are computed on a drop in pressure of 0.04 inch per section. A section is the length between two consecutive branches or outlets. The maximum drop is limited to 0.1 inch in 30 feet. The formula used is:

$$Q = 1{,}350 \sqrt{\frac{d^5 \ h}{0.65 \ L}}$$

Where Q = quantity of gas in cubic feet per hour; d the

diameter of the pipe in inches; h the drop in pressure in inches of water; L the length of pipe in yards. Diameters used are card, not nominal. For example for ⅜-inch pipe the diameter ⅜ inch is used, not the diameter 0.493 inch which is Briggs' Standard.

12. This is to provide for extreme cases. For example, if it were necessary to supply a ¾-inch outlet through 540 feet of pipe, it would be necessary to use, if the table were followed, 24 feet of ¾-inch pipe, 70 feet of 1-inch, 100 feet of 1¼-inch, 150 feet of 1½-inch and 196 feet of 2-inch. In most cases it would probably be possible to safely reduce the size of a portion of the line by a study of the actual delivery required at the end, and of other local conditions.

THE CHAIRMAN: We have a discussion here by Mr. Walton Forstall.

MR. WALTON FORSTALL: (Written discussion communicated.) From as close a study of the report as I have been able to make in the time at my disposal, it appears to me to be admirable, both in what it includes and what it omits. I am particularly pleased in the use of the twelve "Notes." I believe that the Distribution Section should recommend to the Institute that this report be carefully considered by all of the members during the coming year, and, further, that the Section should be prepared at the 1917 meeting to recommend the report with such changes as may be deemed advisable, to the Institute for adoption as the Institute standard.

As it is only too well known that in matters of this kind, the individual members of the Institute will never take the initiative, the coming year's Committee on Gas Housepiping should get in touch with at least the larger gas companies of the country and try to force the issue as to why these companies should not model their housepiping requirements upon this report. I use the word "model," because, in most instances, there probably will be local conditions that will demand certain modifications of the standard specifications.

The Institute is to be congratulated upon the result of the work of the Committees on Gas Housepiping for this year and last year, as evinced in this report.

THE CHAIRMAN: We have another written discussion I think should be printed without being read as this entire subject will be continued in co-operation with the Committee on the Gas Safety Code.

MR. H. B. ANDERSEN (Philadelphia): On page 1016 the practice of bending pipe to form outlets is mentioned. It would be interesting to hear from the advocates of this practice its advantages, because its disadvantages are so serious when compared to straight pipe fitting, especially (*a*) greater probability of leak, due to sharp bend in pipe; (*b*) higher cost of installing; (*c*) less assurance that outlet will be exactly at right angles to ceiling or wall; (*d*) impossibility of shortening outlet below ceiling or at wall, in cases where a tee is to be placed between the outlet and the fixture, and exposed pipe run along the ceiling. Shortening is sometimes necessary, so that the exposed pipe will be close to the wall or ceiling; (*e*) absolute impossibility of making repairs to any such bent pipe, without greatly disfiguring the ceiling, floor or wall; (*f*) less assurance that a fixture will be as rigidly supported, because the bent pipe outlet cannot be fastened as close to the outlet.

Experience with a large number of bent pipe outlets installed about 20 years ago shows that many of these pipes split at the thread, when the old fixture is removed.

The only argument against the straight pipe fitting method is the possibility that the outlet nipple, when once screwed out, perhaps cannot again be entered; and that this creates a very dangerous condition when an inexperienced person is doing the work, with gas pressure on. Theoretically this is true, but the cases in practice where damage has resulted, are very few, if any.

On page 1020 is given a table showing proper supporting points for piping. It is probable that vertical pipe, even as small as ⅜ inch, needs no support except at each floor level. This seems of minor importance, but in some cases it would increase the cost of the job considerably, and if it is not necessary it should be omitted.

On page 1022, the approved mercury gauge is mentioned; in the following paragraph a test by a 6-inch water column is prescribed. Should not the water gauge also be mentioned?

On page 1023, line 5, the word "first" is probably in error, and should be stricken out.

On page 1024, the Table of Sizes would be very much clearer if accompanied by sketch showing a sample system, and explaining in great detail how the various sizes are determined. It should be remembered that this information will be used by many men without much education, and so to minimize mistakes, which are expensive to correct, each rule should be made as clear as possible.

One of the most important features in connection with rules for gas housepiping and a feature that grows daily in importance, is that these rules should impose no unnecessary burden on the plumber. Each rule should be carefully studied, and none that shows evidence of impracticability, or which the gas company intends not to enforce, should be permitted to remain.

Mr. A. M. Boyd (Philadelphia): (Written discussion communicated.) The report of your Committee on Gas Housepiping is in my estimation very complete and covers the subject in its entirety.

There are, however, one or two points in the report about which I would like to make some suggestions.

On page 1015, paragraph headed, Pipe and Fittings. The last sentence in this paragraph reads "Galvanized fittings will be permitted and fittings galvanized on exterior only are preferred." It would seem to me from this wording that the use of ordinary black malleable fittings is preferred to galvanized. This is contrary to the rules of most gas companies that now provide a specification for the plumbers to follow. In my experience I have usually found that the galvanized fitting is preferable to the black and much less likely to have imperfections such as sand holes, etc. In the less commonly used sizes above 2 inch and certain odd sized reducing fittings

where it is difficult or impossible to obtain anything except the black it is frequently necessary to procure three or four fittings of each of the sizes necessary in order to obtain one that will be tight and stand the pressure that is required. It is an extremely expensive proposition to remove and replace a defective fitting in the line after the housepiping has been run and these defects are frequently not noticeable until the piping has been completed and tested. The galvanizing process fills up these small imperfections and reduces the probability of a leaking fitting being placed in the line and the consequent danger of a careless workman attempting a form of repair that should not be permitted. I believe that it would be much better to have the paragraph in question read that galvanized fittings are preferred and that if fittings galvanized on the exterior only are obtainable they should be used in place of fittings galvanized both on the interior and exterior.

On page 1015, paragraph, Obstructions in Pipe. This paragraph specifies that piping must be free from burrs or other obstructions but no mention is made of the advisability of reaming pipe. The policy of reaming pipe is not by any means universal and it might possibly be considered difficult or inadvisable to enforce such a provision in a set of rules of this kind but I believe that the moral effect of an expression in favor of reaming pipe from the Committee would have considerable influence with the plumbers who will be guided by the requirements of this report. In the larger sizes of pipe the reaming is not so important but in the smaller it is, I believe, very necessary. I have seen many instances in the smaller sizes of pipe where a combination of improperly applied joining material and a heavy burr on the interior of the pipe have together greatly restricted the pipe opening and in such cases trouble from insufficient supply is sure to follow. The proper application of joining material is difficult to regulate and under the best of conditions it will, at times, be applied to the fitting in place of the pipe thread. The specifications that the pipe should be reamed, in the report, would, I believe, have considerable influence on the plumbers.

On page 1016, paragraph headed, Breaking Sizes. This paragraph at present is not entirely clear to me and I am inclined to think it is capable of some misinterpretation. The instructions that when an extension is to be made, the pipe must always be broken at a point where the full size can be maintained would seem to imply from the wording that the same size pipe that is cut must be continued in the extension. I do not believe that this is the interpretation intended and would suggest that this paragraph should be so worded that it could be more readily understood. My understanding of the paragraph is that no pipe extension is to be made from a line of smaller size pipe than the extension being made.

On page 1017, paragraph headed, Building Service Header. In every instance where it is necessary to set more than one meter in a building there are usually numerous complications with reference to the location of such meters. I would, therefore, suggest adding a note following the paragraph as at present written to the effect that in all instances of multiple meter sets the gas company be consulted by the piping contractor before making the final riser extensions to the head of the supply service.

On page 1023. In the table given at the bottom of the page the equivalent number of outlets for certain separate standard appliances is given, inasmuch as water heaters are of three separate distinct types, Circulating, Instantaneous and Automatic, I think that the word circulating should be inserted before water heaters shown in this table so that it will be clearly understood just what type of water heater a pipe sufficiently large to supply five outlets will supply. I would also suggest the addition of gas engines to this table, stating the equivalent number of outlets for each horse-power of a gas engine. It might also be advisable to add a note at the bottom of this list stating that the number of outlets for other appliances, not mentioned in this list, could be obtained by consulting the gas company.

Page 1026, paragraph 7, deals with the question of the advisability of running the supply for side outlets from above or

below. Preference is given in this rule to the supply from above. Would it be advisable to suggest that in instances where additional piping would be necessary if side outlets were supplied from below to have the extension taken from a supply line above but to provide a drip in the form of a nipple and tee below the point from which the outlet is taken off. This would provide for an accumulation of a considerable amount of condensation and it is unlikely that this drip would ever fill up and require attention.

I believe it would be well to insert an additional note in the present collection specifying the importance of having plumbers properly tag all risers where there are a number of meters to be set in one location. This is very necessary even where it is the gas company's policy to later tag in a permanent way the risers after the meters are set. The proper inspection of individual supply lines by an inspector from either the gas company or municipal authority is difficult unless the different risers are tagged by the plumbers in such a manner that the apartment or room they supply is clearly designated.

MR. RUSSELL: I understand, Mr. Chairman, these discussions are printed in the PROCEEDINGS later?

THE CHAIRMAN: Yes, but there will be no action taken by the Institute until next year.

I will appoint the following gentlemen on the committee to draft the resolutions for having the specifications on fixtures and fixture cocks printed: Mr. E. B. Myers, of Philadelphia, Pa., and Mr. H. C. Blackwell, of Davenport, Iowa. I wish you would report this afternoon, if you will.

On motion the meeting was adjourned until 2 o'clock P. M. of the same day.

DISTRIBUTION SECTION

Third Session, Thursday, October 19, 2:00 P. M.

Mr. J. D. von Maur, *Vice-President,* presiding.
Mr. G. I. Vincent, *Secretary.*
The Chairman called the meeting to order at 2 P. M.

The Chairman: A Committee was appointed this morning to draw resolutions with reference to the printing of the specifications of gas fixtures and gas fixture cocks. I will have the Secretary read the resolution.

Secretary Vincent: (Reading.)

"The American Gas Institute's specification for gas ranges and the American Gas Institute's specification for gas fixtures are the same as the specifications adopted by the National Commercial Gas Association. There is need for these specifications in pamphlet form, and we therefore recommend to the Institute that an agreement be reached with the National Commercial Gas Association for the joint publication of these pamphlets under the titles, "Standard Gas Range Specifications Adopted Jointly by the American Gas Institute and the National Commercial Gas Association" and "Standard Gas Fixtures Specifications Adopted Jointly by the American Gas Institute and the National Commercial Gas Association."

The Chairman: You have heard the resolution. Is there any second?

(Motion seconded and carried.)

The Chairman: We will now have the report of the Committee on Cast Iron Pipe Joints, of which Committee Mr. Vincent is Chairman.

REPORT OF COMMITTEE ON CAST IRON PIPE JOINTS.

Introduction.

Your Committee on Cast Iron Pipe Joints begs to submit the following report of progress.

A preliminary report of the committee was submitted at the meeting of the Institute held in San Francisco in 1915 and there read by title. In order to promote discussion the report was published in the December number of the Institute *News* and discussion requested. Several interesting discussions were submitted and published in subsequent issues of the *News*. The report, together with these discussions in full will be found on pages 311 to 343 of Vol. 10 of the PROCEEDINGS of the American Gas Institute.

It was assumed by your committee at the outset that the ultimate object of the committee's investigation would be to present to the Institute a standard form of making cast iron pipe joints. No restrictions whatever were placed on the activities of the committee. It was assumed, however, that it was desirable to depart as little as possible from the standard form of cast iron pipe, *i. e.*, it was considered inadvisable to recommend any radical change in the form of casting unless it could be clearly shown that such a change would result in very greatly improved efficiency.

The preliminary report covered the work of the committee up until the time of presentation. It was largely made up of a definite set of specifications for making cement joints. Although cement joints have been used for a number of years, this is the first time that a definite set of rules has been published. The report embodied a recommendation that cement joints should be used in standard bells up to and including 8-inch mains under all normal conditions. The committee has no exact data as to just how many companies have adopted the specifications. A number have used it during the year 1916 either in whole or in part. Reports on the results of the adoption of the specifications have been exceedingly gratifying. Your committee fails to see how there can be any adverse criticism of a set of specifications that simply put in scientific form that which we were heretofore doing more or less crudely by some rule of thumb method.

Suggested Additions to Cement Joint Specifications.

Some further investigation and the practical use of the specifications have suggested two additions.

In paragraph No. 6 of the specifications on page 319 of the Proceedings, more emphasis should be placed on the fact that the spigot must be pushed home in the bell until there is no question but that the joint is iron to iron and will continue in this condition. While this is generally understood, it is in the opinion of the committee a very important point because the cement joint, while strong enough to resist all temperature changes due to contraction of the pipe, is comparatively weak when subjected to stresses due to expansion. By having the joint iron to iron a stress due to expansion would not be carried by the joint.

There should be added another paragraph specifying that the joints should not be "broken." By breaking joints is meant the laying of joints slightly out of line in order to run a main around a curve. Some experimental and practical work indicates that for 12-foot lengths in 4-inch, 6-inch and 8-inch mains cement joints can be satisfactorily and permanently made when the center line of the pipe is off-set 5 inches in each 12-foot length. This represents the maximum that should be permitted under any conditions whatever. Where more curve than this is desired curved pipe should be used, cut to the proper length.

Comments on Submitted Discussions.

The discussion by Mr. O. B. Evans, page 333 of the Proceedings, covers the results of a series of experiments made by The United Gas Improvement Company which in the opinion of your committee are the most valuable and carefully worked out of any experiments that have been made along this line.

There is one anomalous condition very clearly brought out in Mr. Evans' discussion which is important because of the divided position that the committee has taken in regard to large cement joints.

On page 335 Mr. Evans states that theoretically a 20-inch cement joint will have a strength of 170,000 pounds, and on the same page that the theoretical strength of a 4-inch joint is 41,000 pounds. These figures are based on a strength of bond of 250 pounds per square inch, and a shearing strength of the cement of 2,400 pounds per square inch. The experiments made by Mr. Evans included three 20-inch cement joints. Two of these, each 10 days old, failed completely at a load of 41,000 pounds and one 51 days old, failed slightly with a load of 10,000 pounds. The largest of these figures is less than the theoretical strength of the bond alone without any allowance for the shearing strength of the cement. It therefore seems probable that the specimen joints were not made in such a manner that the full strength of the bond and shear would be realized. This condition would be at least approximated if the specifications for cement joints offered by the committee were followed. These specifications were not in existence at the time the experiments were made. Cement joints made by the old method in a manner similar to that described on pages 377 to 380, "Catechism of Central Station Gas Engineering in the United States," would result in a joint in which no part of the cement would be in shear. In other words in a joint in which the greatest strength of the cement, the shearing strength, plays no part.

Mr. Evans also states in his report, page 335, "The usual form of rigid joint is a cement joint and this in practice has failed for large size pipe." Such a statement should not be taken without some modification. Your committee has found that in a number of situations cement joints in large mains have been entirely satisfactory in standard bells. In other situations where it seems absolutely certain that the joints were made with equal skill and care it is true that they have been a failure.

The results of The United Gas Improvement Company experiments seem to indicate that a combination joint made of yarn and cement with a ring of lead or lead wool in front carefully caulked would make the most satisfactory joint for large mains and in the absence of further data it would seem best

to continue to use this type of joint until something more satisfactory is developed.

The discussion of Mr. von Starzenski, page 342, contains some interesting comments among others suggesting that we are going too far if we insist on spacing joints in small mains with wedges instead of packing. It is interesting to note that there were more comments on this point than any other part of the specifications.

Your committee can see no reason whatever why, because we have made cement joints by some method more or less hit or miss up to this time, there should be any inherent objection to adopting a few simple standard tools. In the situations where these wedges have been used and thoroughly tried out the reports have been uniform that the results were an improvement. The reports have also indicated strenuous objection on the part of the old time joint makers to any such innovation. Some improvement has already been made in the use of wedges. It has been found that for small work two wedges at the bottom are sufficient and in one situation that has gone into the matter probably more thoroughly than any other these two wedges are joined with a short saddle. Pairs of wedges are provided for each size main and the joining of the pair together makes it a very simple tmatter to space joints. The workmen rapidly become expert and by using the pair of wedges can space the joint perfectly without any adjusting whatever. Certainly the spacing is superior to that which could be secured by the old method of using the yarn. And it is equally certain that the placing of the back yarn will be improved. However, these points are fully covered in the preliminary report.

The discussions by Mr. Forstall and Mr. Lemoine are also interesting. Both of these gentlemen have greatly assisted the chairman of the committee by furnishing data.

Work of Committee During Year.

Subsequent to the presentation of the preliminary report the committee was continued and has been at work during the year in collecting additional data, particularly from large situations

and endeavoring to arrive at some definite conclusion as to the ultimate form which the report will take. At least two series of experiments are underway but the data is not available as yet.

One series of experiments has been made to endeavor to determine with some degree of accuracy the true strength of the bond between the cement and the cast iron in the cement joint and also the true shearing strength of the cement. This experiment has not been completed but enough data has been secured to indicate that the 250 pounds per square inch which has been used in all the theoretical calculations as the strength of bond between the cement and iron is far too low; certainly in small joints. A safe figure for the ultimate strength would probably be 400 pounds per square inch.

The data collected from a number of the larger situations has added much to the knowledge of the members of the committee but has greatly increased their difficulty in endeavoring to formulate a report covering specifications for joints under all normal conditions. For example, a number of well operated large situations are still using cast lead joints in small mains. In one instance at least your committee believes that this decision to continue the use of lead joints in spite of the advance in the art of making cement joints was justified. In other situations it is doubtful. However, as it is largely a matter of opinion your committee feels that it would be wise to include in the final report a specification for making lead joints. This would not be difficult as it would simply mean revising some of the specifications published in the past, adding and modifying from the experiences of some of the engineers who are still using the lead joints.

Another interesting point was the extensive use of clamps to go over standard bell and spigot pipe. Several types of clamps have been examined by the committee. None embody all the essentials which your committee believes necessary to have in a clamp of this kind.

Another interesting point is the very little use of any special form of cast iron pipe joint. One of the proprietary forms

of special machined end pipe was reported in several locations usually with adverse criticism. Turned and bored pipe used largely abroad seems to be entirely absent in this country. Flange pipe is used to a very limited extent. One small stretch of plain end pipe with special couplings was reported. As far as could be ascertained no threaded cast iron pipe is being used.

The use of the combination cement and lead joint is being extended. One engineer reports the use of the combination joint and states that he pours a cast lead joint on the cement immediately after placing the cement in the joint and cleaning out the space in front. Kerosene oil is used for a flux to prevent blowing. It is stated that this results in a very spongy lead ring which can be driven back with almost the efficiency of lead wool and of course is very much cheaper. It seems highly probable that the setting of the cement would be largely prevented by any such method but as the cement is not intended to play any part in making the joint gas tight, this would not be particularly objectionable.

Several situations have almost completely gone over to the use of steel pipe with welded joints. Of course these situations have no joint problems. On a straight dollars and cents basis the use of welded steel pipe was probably justified in the cities reporting. Of course this should not be all of the elements affecting the choice. The geographical location, the adjacency of other structures, soil conditions, and probable effects of possible serious leaks all should be considered.

It will be seen from the statement of conditions made heretofore that it would have been practically impossible for the committee to present a satisfactory final report. If the Institute decides to continue the work of the committee your present committee suggests proceeding along the following lines.

Proposed Committee Work.

1. The investigation with the idea of producing a satisfactory cement joint for large mains should be continued. If possible, definite figures as to the strength of the bond and the shearing strength of the cement should be secured first for small mains

and then these figures should be applied to the designing of a joint for large mains which in turn should be tested in the laboratory under conditions approximating as nearly as possible to the practical conditions of main laying. If the large joint showed under test the anticipated strength the problem would be practically solved. If it failed to show any such strength the investigation should proceed to endeavor to determine just why this condition exists.

With the data available at this time it is not possible to prepare specifications for large cement joints in any such definite form as has been offered for small joints. If, however, the design is eventually forthcoming it would surely be worth the expenditure of time and money which apparently will be required. A satisfactory cement joint for large mains would represent a large saving in installation work in the industry.

2. As cast lead joints and lead wool joints and combination joints will continue to be used specifications should be prepared for each of these types of joints. The idea of preparing these specifications is that the engineer or manager can hand them directly to the men responsible to him for the joint making, knowing that if the specifications are followed satisfactory work will result. As explained before, the preparation of these specifications will present no particular difficulty and should require no experimental work. The specifications for cement joints as given in the preliminary report of the committee will have to be slightly revised and rewritten.

Your committee appreciates that it will be impossible to write specifications for the various types of joints that will be satisfactory to everybody. For example, representative engineers in the industry are divided in the ratio of about three to two on the question as to whether blocking shall be used. The preliminary report of the committee did not recommend the use of blocking for small mains under normal conditions. The report fully covers the point and it is further covered in a paper read heretofore before the Institute by one of the members of the committee.

3. The committee should investigate the special form of cast iron pipe joints, such as flange joint, turned and bored, plain end, etc. The merits of each of these special joints should be thoroughly examined. It is probable that definite conclusions can be reached without any experimental work. These conclusions should be presented in the final report of the committee together with relative cost. It would not be necessary to give these costs in dollars and cents but they could be expressed as a percentage of some basic cost such as the cost of a cement joint in standard bells.

4. A clamp to go over standard bell and spigot pipe should be designed. By using the best of the ideas already embodied in clamps that have been prepared for the trade or have been prepared by engineers for their individual use, it should be entirely possible to devise a clamp that would be satisfactory for general use. The form of packing to be used with the clamp should also be carefully considered by the committee. Your committee thinks that it will be clear to any engineer who has had experience with the various types of proprietary clamps, that the preparation of a standard form will not be by any means a simple matter but it would seem to be entirely possible and could probably be satisfactorily worked out by a committee.

5. If possible the final report of the committee should embody recommendations of the types of joint to be used under the several pressure conditions, *i. e.,* low, medium, and high. This might or might not be largely a matter of opinion. There is not sufficient data at hand at this time to draw definite conclusions, although sufficient information has been gathered to indicate that it will not be difficult to make reasonably specific recommendations for small mains.

These five suggestions are made for discussion at this meeting. They represent what your committee believes should be undertaken by the committee if it is proposed to continue this work. Your committee further believes if the five queries are satisfactorily answered the final report will have a large use in the industry.

RECOMMENDATIONS.

Your committee, therefore, recommends that,—

1. The outline of the proposed report be freely discussed and criticised at this meeting.

2. That a committee be appointed to continue the work and present a final report at as early date as possible, embodying the suggestions as outlined, with such modifications as may be brought out by discussion at this meeting or which may be recommended by the Technical Committee.

Respectfully submitted,

G. I. VINCENT, *Chairman,*
J. A. CLARK, JR.,
R. A. JAYNE,
G. T. MACBETH,
W. H. TAYLOR,
J. D. VON MAUR.

THE CHAIRMAN: You have heard the report. It has been arranged to continue the Committee and the work will be continued. I have a written communication by Mr. Walton Forstall, which Secretary Vincent will read.

MR. WALTON FORSTALL (Philadelphia): (Written discussion communicated.) The importance of the Committee's work is emphasized in my mind by its statement of a well-known fact, namely, "A number of well operated large situations are still using cast lead joints in small mains." That this can be so, when Philadelphia's record, since 1902, shows 460 miles of mains 12-inch and smaller laid with cement joints, with a total of less than 250 leaky joints, only illustrates how natural it is for different situations to work along different lines. Apparently, the user of cast lead for small mains fails to realize the great saving that could be made by the adoption of cement. Education is needed and this will be furnished by reports such as the one now under consideration.

Before next year we hope to have something to say in the way of a comparison between cement joints as made by the old method and as made under the specifications advocated by

the Committee. Unfortunately, for our activity in a matter of such a comparison, our small main joints, as made under the old method, have proved so good that there has been no impelling motive to change our practice, although I think the Committee's point is well taken, that the new joint should be stronger than the old one.

In the matter of large cement joints, I hope that some tests can be made during the coming year to ascertain the actual strength of joints made by the proposed specifications. Undoubtedly the joint question is one of the most important purely distribution questions needing investigation."

THE CHAIRMAN: The paper is now open for your discussion. I might say that in reading Mr. O. B. Evans' discussion of the Committee's report, it is very evident that one of the most important matters which enters into the strength of the joint is the value of the adhesive strength of cement to cast iron when used as in the cast iron joints. There has never been any experiments made to determine this value. The figures quoted in his paper are 250 pounds to the square inch. But that is not for neat cement, between two unresisting surfaces, and well bonded together as we have in the case of a cast iron bell and spigot joint. I spoke with the engineers of the Robert Hunt Company, and they stated that while no test had been made, they were positive the value would be much greater. I then wrote to the Bureau of Standards at Washington, asking for data, and I received this reply to that letter, which I will ask the Secretary to read.

SECRETARY VINCENT: (Reading.)

DEPARTMENT OF COMMERCE.

August 14, 1916.

Bureau of Standards, Washington.
The Laclede Gas Light Co.,
St. Louis, Missouri.
Gentlemen:

(Attention Supt. of Distribution.)

Your letter of August 8, addressed to the Bureau of Stand-

ards at Washington, has been referred in part to this branch of the Bureau for answer. I do not know of any tests having been made to determine the adhesive strength of neat cement with iron or steel when the cement had been compressed. The adhesive strength of cement when used in concrete with steel re-inforcing has been investigated by a number, especially by Professor Abrahams, formerly of the University of Illinois. The value which he gives, as I remember it, is in excess in that of which you mention, *viz.*, 250 pounds per square inch. Without looking up his results, I believe he found this value to approach 600 pounds per square inch. Of course when the cement would be compressed, particularly in the dry state and then allowed to harden in place, the adhesive strength would undoubtedly be higher, since during the setting expansion results.

We do not know of any cement which would expand uniformly; in fact, the cements which show the greatest expansion are those less desired for the most purposes. The cement which shows the minimum expansion is most desirable. If they show too great an expansion they would be rejected by our ordinary tests. Those which show the greatest expansion are unsound and will disintegrate in time. I do not see why you should have any better success by using Dyckerhoff cement than any domestic cement. Part of the output of the Dyckerhoff plant is produced by methods not at all used in this country and methods which are gradually being replaced in Germany, Such methods of production tend to produce a very ununiform form of material.

Yours very truly,

(Signed) P. H. Bates,

For the Director..

The Chairman: The need of this data is particularly important in the case of large mains. We are all pretty well satisfied we can make cement joints up to 12 inches. I do not remember a leak on a low pressure main in St. Louis, but we have had them on 24-inch high pressure and 30-inch low pressure mains. So we must know our theory is correct before

we make practical applications on so large a scale. We must, therefore, have this unit strength, and know our theory is right before we proceed in such practical experiments.

Mr. A. M. Boyd (Philadelphia): It is my opinion that the work of this Committee and the data collected by them is of the greatest interest and importance to the distribution engineer and represents the first real step forward in the march of progress since cement was first utilized for cast-iron joint making.

Cement joints have, as your Committee points out, been successfully used by the vast majority of companies for the last 15 years or more but in all of that time few, if any, changes in the method of making the joints have ever been made or recommended. The only material differences of opinion in the past as to the method of making the joints was with reference to the kind of cement or yarn to be used, and in general the cement joint in one situation differed from the joint made in another situation only in the details of workmanship which the individuality of the workman permitted.

It is now proven by the work of your Committee that this method, not founded on any scientific experiment, has proven satisfactory more by accident than by design and while small joints have been uniformly satisfactory large joints have not.

In order to raise the cement joint making to a plane above the hit or miss class and place it where it belongs among the arts of a skilled mechanic the Committee submits and proposes for adoption the rules formulated in this and their previous report.

I believe that it is of utmost importance for all gas distribution engineers to have copies of the rules for the proper making of cement joints placed in the hands of the men who do main laying and urge and encourage these men to adopt the Committee specifications for the making of all joints of the smaller sizes.

If by encouraging the men to do careful and skilled work on the small main joints we can pave the way for the exer-

cise of the same amount of care on the large main joints, we will be in a much better position to quickly adapt conditions to the properly made cement joint for mains of all sizes if the Committee proves that cement can be made to successfully perform the duty required of it.

I, therefore, believe that it is the duty of all engineers to accept and try out the suggestions of the Committee and by their example overcome the prejudice of the workmen who have in the past been following the dictates of their own personal experience.

Mr. G. I. Vincent: I understand Mr. Evans assumed 250 pounds. The only tests I know to give the adhesive strength or the strength of bond between cement and iron, as used in the ordinary cement joint, were made in Des Moines. The testing machine was not large enough to determine the shearing strength, but the strength of bond with green joints was far in excess of 400 pounds per square inch, so that the 250 pounds is entirely too low. I think it would be perfectly safe and correct to use 500. We propose next year to determine the working figure for the adhesive strength, and the working figure for the shearing strength. It is probable that the figure of 2,500 pounds for the latter, used in the calculation, is also too low.

The cement joint, as ordinarily made, could not properly include the shearing strength across the lead ring, as the cement does not extend across it. The specifications prepared by the Committee had that in mind and if followed the cement will extend from a point back of the spigot bead to, and in front of the lead ring, so that the cement in the lead ring will certainly be in shear.

The Chairman: We are indebted to this Committee, and especially to its Chairman, Mr. Vincent, for some very fine and hard work on this subject.

We will now take up the next paper, "Unit Cost in Distribution Work," prepared by Mr. A. A. Treadway. Mr. Treadway will present the paper.

UNIT COSTS IN DISTRIBUTION WORK.

Unit costs in distribution work would be of no value to a person studying them with the idea of finding out by comparison with his own costs whether the latter were satisfactory or too high. The only way in which such information would be of any value whatever would be to have such unit costs derived from a uniform system of accounts in the companies compared. Even then the value would be small because the conditions of operation would be different, and while a unit cost of a certain operation might be, let us say X in one place and 2X in another, still in both places it might be highly satisfactory and the best result possible. Therefore, it seems best to revise the subject to the following: The Effect on Unit Costs of Certain Changes in Methods in a Shop Division of a Distribution Department.

In dealing with this subject we will consider the following classes of work:

1. Automobile Delivery Bonus System.
2. Motorcycle Inspection.
3. Handling of Complaints.
4. Handling of Off and On Orders.
5. Sale and Installation of Gas Ranges.
6. Sale and Installation of Tank Water Heaters.
7. Sale and Installation of Automatic Water Heaters.

It should be borne in mind that the impetus given to us to devise changes came in part from local conditions. The city is prosperous and labor is paid higher than the average throughout the country. We are in the city of the Ford Company with its highly advertised $5.00 per day men. Change and progress are in the air, and we believe progress has taken place in the Gas Company.

1. Automobile Delivery Bonus System.

After experimenting with numerous automobiles with vary-

ing success we decided on the use of a popular low priced car and devised a bonus system of paying drivers to promote careful driving and to insure the care of the car. We opened up an account in the expense ledger for each car, to which was charged all work done on the car together with a pro rata share of the overhead of the garage. We issued instructions for automobile drivers on card board, so that they could be fastened onto the dash of each automobile. We wrote each driver explaining the system (See Exhibit A). In operating expense we included everything except insurance and depreciation. The cost of operating our automobiles is less than previously, and about as follows, for five of them:

	1	2	3	4	5
January	$61.83	$34.27	$23.04	$60.06	$16.80
February	48.35	29.53	22.32	21.35	14.66
March	37.90	41.62	36.71	41.83	12.51
April	31.80	44.02	56.58	16.06	11.50
May	29.16	40.05	32.89	14.29	38.10
June	66.37	107.64	42.54	26.00	15.34
July	49.97	78.59	60.02	47.64	26.74
August	21.58	45.70	60.50	48.04	80.41
September	26.28	39.31	53.40	62.09	47.51
October	15.77	98.51	79.03	36.58	69.49
November	28.27	28.69	121.56	73.92	38.47
December	13.93	23.98	45.93	——	——

We opened up a subsidiary ledger with an account for each driver.

We arbitrarily set 6 cents per mile as a basis on which to pay bonuses. One-half of all operating expense under 6 cents per mile in each month was credited to the driver. All expense over 6 cents per mile in each month was charged to the driver. We paid at the end of 1 year's operation, when we traded the chassis in and bought a new one. At the end of a year bonus accounts for a few of our cars were as follows:

Car	Driver A.	Driver B.	Driver C.	Total Paid
No. 1	$125.00	——	——	$125.00
No. 2	72.92	$52.08	——	125.00
No. 3	82.70	——	——	82.70
No. 4	22.90	61.05	——	83.95

If at the end of a year the sum of the debits was in excess of the sum of the credits for a driver the latter did not get anything nor was he penalized. He started the new year with renewed determination to make something the next year.

A few points to be emphasized are:

1. We had statistics of the mileage covered by each car.
2. We had the cost as near as could be found of operating each car.
3. We could safely place all responsibility for lubricating and inspecting on each driver, and thus cut down our garage force. We also were able to cut down our garage force because of our adopting one kind of a car that could be repaired quickly and cheaply in the local service station.
4. We determined each month the unit cost per mile and cost per hour of each car, and at the end of a year summarized and averaged each. In this way we could compare the costs with the costs of previous years, when other cars were used or with the same kind of cars not on the bonus system, such as those driven by foremen or superintendents.

2. Motorcycle Inspection.

We handle our cost data with motorcycles owned by the company in much the same way as we keep that of automobiles, except that no record of the mileage is kept. We simply open up an account for each motorcycle and an overhead account, and charge each machine with all direct expense and charge each motorcycle with an equal share of the overhead.

Because of the frequent minor accidents to motorcycles and petty purchases it occurred to us that this could be avoided if the motorcycles were owned by the inspectors themselves, so the following plan was devised:

We sold the motorcycles to the inspectors at the price standing on the books, charging the personal account of each inspector. We then allowed each driver $15.00 per month plus oil and gas. We deducted $10.00 per month from each man's pay, crediting his personal account. This left him $5.00 cash per month to take care of repair bills, tire renewals, etc. This plan has worked very well, with the exception of certain men turning on and off meters. They gave their motorcycles such severe service that some went into debt. We are now considering giving them $20.00 per month plus oil and gas.

The advantages may be summed up as follows:

1. Better care of motorcycles.
2. Less delay in getting orders through the office for purchasing repairs.
3. Minor repairs made with least expense to driver and loss of time to the company.

3. Handling of Complaints.

In this work we perhaps made the greatest changes, some of which were made necessary by the rapid growth of the city. Our complaints after being received in the office of the Shop Department were given to men in the morning and at intervals during the day over the 'phone. These men rode bicycles and covered certain districts. If they found a condition they could not remedy, such as a stuck meter, plugged service or riser, bad leak or D. R. meter, they called the office and a meter would be sent out as soon as possible by a special messenger or regular meter driver, if such could be found. Sometimes there was a delay of several hours. If a service was plugged, the office would be notified and a blow-out wagon dispatched to the scene as soon as possible, often times the next day. There were many objections to the blow-out wagons, such as slowness in getting around, loss of time in refilling air tanks,

etc. Each wagon had a compressed air tank which was filled from a compressor in the basement of the gas office building.

COMPLAINT AUTOMOBILE.

METER SETTING AUTOMOBILE.

In the first place we replaced the three blow-out wagons, each of which carried a man and helper, by light automobiles (see picture). On each automobile we installed an air pump

connected to the motor, and tank with necessary gauges. On each automobile was an open box body with compartments for meters, service regulators, tool and fitting box and hand air tank to carry into a building. Each machine carries about three meters, two or three service regulators and miscellaneous fittings, together with an alcohol can in winter.

We put two men on motorcycles to help out and take care of special and other complaints where we knew a blow-out service would not be necessary. We have two other men who do special work, such as special meter sets, rush complaints, and might be styled as "utility men." There are two other automobiles that are used for complaint work sometimes, one of which carries an air pump. It is also used at times for setting and removing meters. The other is used in fitting work when complaints are few. By these changes we were able to derive the following advantages:

1. Reduction in the unit cost of complaints handled, 28 per cent.
2. Better and quicker service.
3. Increase in pay to complaint men about 10 per cent., besides an opportunity to earn a bonus on the operation of their automobiles. This amounts to another 10 per cent., approximately.

4. Handling On and Off Orders.

When a meter is already in a place where gas service is desired or the service is ordered discontinued, either an "On" or "Off" order, as the case may be, is issued to the shop. Formerly these were executed by men, each in a more or less flexible district, who rode around on bicycles. We purchased motorcycles for them under the arrangement as described in Sec. 2 of this paper, and also established a bonus system of payment as follows:

They were each allowed the hourly rate which they had been receiving, but with the understanding that no overtime would be allowed. They were expected to execute 50 orders per day, providing there were enough orders to go around on

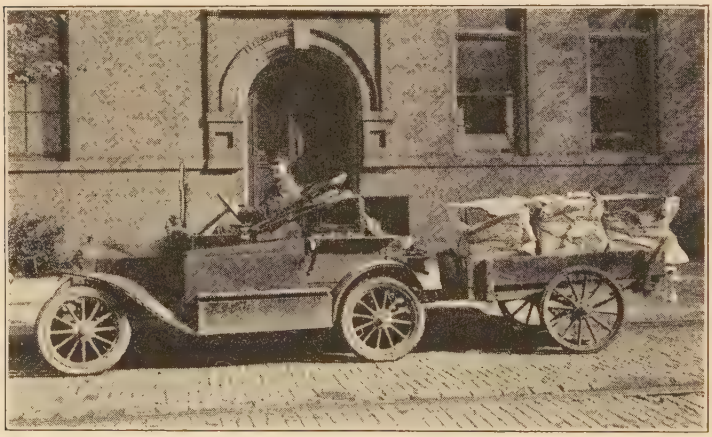
this basis. For each order executed over 50, an extra payment of 10 cents each was allowed. While this was about 2½ to 3 cents more per order than the average paid for labor before, we made this payment on the theory that the extra orders would require more effort to execute than the first 50 because of fatigue and was hence worth more to the men themselves. For the months of May, June, July and August of 1915, the average daily wage for four out of five men was $2.24. The average bonus paid to each was $1.30, making a total of $3.54. Of course, there were months of maximum activity, and during the winter months very little bonus could be earned. The advantages of this system of payment were:

1. Fewer men who were willing to make an extra effort at periods of great activity, such as last and first days of month and during certain months when people are prone to move.
2. More speed in executing orders, thus giving better service.
3. Reduced labor and total unit costs.
4. More pay for the men.

5. Sale and Installation of Gas Ranges.

In discussing this part of our service it is necessary to go into the sales plan as the sale and installation are intimately connected. Formerly we sold ranges from the office and by means of salesmen, who called on prospects some of the time and canvassed some. The orders were sent to the shop and executed as soon as possible, sometimes the next day and sometimes later. The stoves were sent out on a 1½ ton truck and a lighter delivery automobile. If the number of ranges to be connected were about average, the men on the trucks would install the ranges. On days when there were an exceptional number of orders, they would deliver the ranges, and additional fitters in two light cars would follow up the two delivery cars and connect up the ranges. Flue pipe would be installed if ordered. This connecting mentioned above applied only to a "Tie on" where gas was already in the kitchen.

Where a fuel line had to be run the work was done by regular fitters as soon as possible, and when run, the order would be turned over to the range delivery department whereupon a range would be delivered and connected in the regular way. This method was found to be unsatisfactory, especially in a month of few sales, such as January, February, etc. The expense of handling was almost as great as when many orders would be executed, so a scheme was devised by means of which the selling and installing could be accomplished by the same men in the same automobile. The trucks were disposed of and light runabouts purchased, on the back of which special open box bodies were installed (see picture). To each car



GAS RANGE DELIVERY AUTOMOBILE.

was assigned a fitter and salesman. The fitter was responsible for the condition and appearance of the car, and received a bonus on its successful operation as outlined in Sec. 1 of this paper. The salesmen met in the office each morning and received prospects, orders for delivery, etc. The fitters reported to the shop, cleaned up their machines, put a range on each car and drove to the office, each one to pick up the salesman assigned to him. A word about the range would not be out of order. We specialized on one model called our "Citigas

Special," on which was concentrated most of our advertising and sales effort. A special price was put on it and many schemes devised to make it popular. We carried this style in stock, but no other. An order for another style meant a delay of a day for the customer and a trip to the stove works for us.

During the morning the greatest effort was applied to selling. This left the fitter idle at times, but not for long. If the salesman succeeded in selling a range he would come out, help the fitter unload it and carry it in, and both would work together setting it up and connecting it onto the riser. After the job was finished and the kitchen cleaned up, the fitter would drive the salesman to the next place to be called on, then drive to the shop for another range. A tag was left on each range announcing that the range was not sold, but that a decision would be asked for next day after a thorough trial.

In the afternoon the time was devoted usually to connecting ranges sold from the office. Because of the number it was found advisable to purchase a trailer for each car, so that three ranges could be carried at once and thus much time was saved in trips to the shop. The trailers are not used while canvassing or selling because of the needless extra load on the car. The salesmen were paid a commission and were offered certain bonuses and prizes for the number of ranges sold. The fitter received his regular hourly rate, but allowed no overtime. For each range delivered and connected over three a day, he received 50 cents. He also received an automobile bonus as before mentioned. The results of this plan were as follows:

1. The sales increased greatly.
2. The time between taking the order and connecting was decreased to from 15 minutes as a minimum to less than a day always.
3. The unit cost of selling was reduced.
4. The unit cost of delivery and installation was reduced.
5. The fitters were paid more, in some cases as much as 50 per cent.

6. Sale and Installation of Tank Water Heaters.

We proceeded in selling and installing tank water heaters, to put into effect as near as possible the plan so successfully used in the case of gas ranges; *viz.,* specializing on one size and make, connecting at the time of sale, and the same day or the next day, if sold from the office; increased pay to fitters, and satisfaction to the consumer.

We adopted the rule of not selling unless there was a hot water tank either connected to a furnace or boiler, or a hot water tank connected to an old type or inefficient gas water heater. We found plenty of such places to keep us supplied with good prospects for a long time to come. We assigned to each two or sometimes three automobiles with open box bodies on behind the seat, a crew consisting of one salesman and two fitters. One fitter was responsible for the care of the machine and earned the automobile bonus as before explained. The fitter drove when possible, but while installing heaters the salesman drove. In the morning the fitters obtained from the stock room, the necessary heaters, fittings, flue pipe, etc., and drove to the office to pick up the salesman, who had obtained the sales orders from the afternoon of the day before, and any prospects in the part of the city where he was to operate. They drove to the first stop and left a fitter with enough flue pipe, fittings, heater, etc., to make the installation. They then drove to the next stop where the other fitter was left with a heater and enough material to install it. The salesman was, then free to call on prospects and try to close sales. He would drive around to the first stop about the time the first job should have been finished and if such was the case would drive the fitter to the next stop, and so on keeping both fitters supplied with material, driving back to the shop if necessary for more. We found by this plan that each fitter could install from two to four a day, usually three. Each fitter was paid his regular hourly rate, with no overtime allowed. Each fitter received bonus of 50 cents for each heater installed over two in any one day. Both the fitter and salesman signed the order

when executed, and the fitter wrote on the back of the order the material used. The salesman was responsible for the workmanship and inspected each job. All heaters were sold on five days' approval and a tag so stating was tied to the heater connections. In no case was a heater installed without a $3.00 down payment, but if at the end of five days the heater was not satisfactory, the heater was removed, the piping replaced in its original condition and the first payment returned. While this plan did not work as smoothly as that governing the sale of gas ranges because of the longer time necessary to install, and unexpected difficulties in installation, it did serve to sell a large number of water heaters, even though we started the plan about the first of June. In 1916 we will start earlier. The same advantages accrued to the company and men as in the gas range campaign except that the bonus payment to fitters did not average so much.

In our 1916 campaign we have changed the method slightly, in that each automobile is driven by a shop man who supervises the fitters—either two or three—instead of by a salesman as in 1915. This was done on the theory that too much time was needed to supervise and take the men around, and too little time was devoted to selling. This year the sales and installing are entirely divorced. The sales orders are sent to the shop and are executed in the manner outlined above.

7. Sale and Installation of Automatic Gas Water Heaters.

In this campaign we tried to standardize operations as in the installation of other appliances with less success. We adopted one line of heaters, and that is about as near standardizing as we could get. In every installation conditions were different as to size of heater, location, length of gas line to be run, installing extra meter, etc. Our sales were made by special salesmen and orders were sent to the shop to be connected by the regular fitting department in the regular way. The heaters were delivered by the company selling them to us. A shop inspector called at the place and noted the kind of fittings and

pipe necessary. The pipe and fittings were delivered the same day or the next and a fitter and helper dispatched to the job to do the installing. A record of the time and materials used was placed on the back of the original order after execution. The job was inspected after completion by an inspector with an automobile with an open box behind the seat. This final inspector picked up the unused material and also moved the men, if still on the job.

In installing a bonus system for these men we were up against a proposition that could not be standardized, so we were forced to consult averages, always unsatisfactory in bonus schemes, to arrive at a basis of payment. We finally allowed the shop the following amounts for labor and material used in each job:

For No. 3 and 4	$20.00
For No. 6	25.00
For No. 8	35.00
Bungalow	15.00

Each job was figured at the end of the month and all saving under the amounts as given were distributed one-half to the new business department and one-half to the fitter and helper. The fitter received the larger share in proportion as his hourly rate was greater than that of this helper. The fitters received in bonuses from $6.00 to $10.00 per month extra during the summer on this plan, but it would be extremely difficult to prove that the bonus system served to induce the men to greater efforts or whether any particular man or men were paid in proportion to their increased efforts, if there were any. We would like to see a bonus system worked out for this kind of a job that would produce better results to the company and greater justice for the men. For 1916 we have decided to discontinue the bonus system for this kind of work because of the difficulties enumerated. We have raised our fitters and helpers approximately what they had earned through bonuses.

INSTRUCTIONS FOR THE USE OF DRIVERS OF LIGHT CARS.
Detroit City Gas Company.
Shop Department.

We believe that co-operation means success.

To get the greatest good out of our new cars we will inaugurate a new plan that will give the careful drivers a share of the savings effected by careful driving. We know a saving can well be effected.

As near as we can compute, the cost per mile to operate should be a little less than 3½ cents. This includes gasoline, oil, tires, repairs, painting and washing. This company will agree, until further notice, to credit each driver with one-half of all the saving under 6 cents per mile in operating expenses. The cost of each car will be kept separately and all expenses of that car charged up against it. Each month the driver will receive a credit for one-half the saving, or a charge for all the expense per mile that is in excess of the allowance of 6 cents. Payments will be made at the end of one year's operation.

The Detroit City Gas Company reserves the right to suspend or discharge any driver for negligence, carelessness, or other reasons as before. If a driver is discharged for gross negligence, carelessness or laziness, he will not participate in the profits for the time he has driven. We will not discharge a man without a thorough investigation and without giving a man a chance to defend himself, as we believe that we can get better results by encouraging our men to better usefulness, than by continually changing because of accidents that may occasionally happen.

If a man is suspended for a period, and then is taken back or has a leave of absence, the man who takes his place will share in the profits, if any, in the proportion of the number of hours he runs the machine to the total number the machine is run for the year in which he drives.

THE CHAIRMAN: The paper is now open for discussion. You may notice that they have a unique way of handling

their business in Detroit. No matter what you think of it, they get the business and get the work done.

Mr. H. B. Andersen has contributed a discussion which the Secretary, Mr. Vincent, will now read.

Mr. H. B. Andersen (Philadelphia): (Written discussion communicated.) The multitude of questions about operating conditions, that arise in one's mind after reading Mr. Treadway's description of his methods, is proof of his assertion that a comparison of the unit costs in two separately developed situations, is of little value, unless it is accompanied by a very full description of the methods of operation employed in the various kinds of work.

Should it ever be that a uniform system of accounts existed in more than one place, a comparison still would be futile, unless the system of obtaining the number of units of work, or in other words, the divisor by which the unit cost could be obtained, was standardized with the same accuracy as the accounting system. Although the probability of any such condition existing is very remote, yet the compiling of unit cost data is work that can be done profitably in any distribution department. In any one situation, a comparison of unit costs, divided as between workmen, or foremen, or superintendents, is almost as valuable as a means of knowing conditions and of lowering costs, as is a comparison made between departments in large but distant cities. Indeed, it is more valuable, for the men compared are no doubt well acquainted with each other, and with the conditions under which the work of each is done, a comparison is a real stimulant to the low man to improve, and to the high one, to keep ahead, because each knows that he is compared with fact and not with theory.

As mentioned, it is very important to record accurately the number of units completed, and it has been found that the best way of doing this is by a systematic count and report, made each day for the work of the preceding day. The orders completed by the workmen and the reports made by the various foreman, usually form the basis for the daily reports.

This report shows the units of work divided exactly in accordance with the system of accounts in use.

Given now the dividend, or the total amount shown by the account, and the divisor, or the number of units completed, the unit cost figure is obtainable. Since the total amount probably can be separated easily into productive labor, productive material, and overhead charge, it is worth while also to divide a unit cost into these three parts. Sometimes a further subdivision of the overhead charge gives valuable comparisons. It is very important that any unit cost report be submitted to the subordinate of lowest rank, who is concerned, as soon after the end of the period represented as possible, for otherwise, conditions existing or changes taking place which affected the unit costs, either have been forgotten or have passed from clear remembrance.

I would like Mr. Treadway to state whether his bonus system applies to all men in his shop division, and if not, in what manner is the lack of opportunity thus to share, made up to these men.

Mr. Treadway's description does not imply necessarily that every salesman selling ranges or water heaters is accompanied by one or more fitters and the auto truck of ranges, but I would like to hear if this is the case; also, whether he works closely to a standard maximum elapsed time between an office sale and a connection; also, whether this scheme would be continued through a gas range week, or through the heavy spring sales peak.

Will Mr. Treadway tell us in what length of time his men complete sixty-three orders per day and what percentage of the working hours is spent in motion between jobs?

Mr. R. B. Duncan (Philadelphia): I have a discussion I have written and will read.

The bonus system of paying drivers to promote carefulness and insure care, etc., seems to me to be open to numerous objections.

The system, as outlined, embraces not only the drivers, but men engaged in other work, as fitters, complaint men, etc. To

offer a uniform bonus would render such a system practically unworkable, for this does not seem equitable for all classes of work. Mr. Treadway's paper acknowledges this in case of "on and off" men; but even with a different bonus for each class of work, the condition would present itself of many men doing many classes of work, and of some doing more of one class than another. Again, different conditions of districts would not warrant a uniform bonus even for the same class of work, a congested section necessitating more frequent stops, slower speed, a greater proportion of unavoidable accidents, etc., so that a mileage or hour record is no indication of a man's title, or rather no title to receive a bonus. It may be, of course, that in congested districts, any unavoidable accident would not be charged against the drivers, but there would be difficulty in deciding just what repairs were necessitated by such accidents and what future repairs could be traced to them. Incidentally, there would be ground for dissatisfaction among the men working under this system—such contentions as to whether repairs were needed, unfairness in replacing defective parts, some men receiving new material, others just as good as new, but not new, possible suspicions as to exchanging tires, on replacements, etc.

Another feature would be the greater temptation to run up easy mileage to the detriment of other work. A man wishing to lower his mileage cost, would be tempted to increase actual cost, both on work and on machine, by taking long but easy route between stops. Besides the above, there would be entailed an increase in clerical work.

There is no man seeking accidents or wilfully crippling his machine. Carelessness metes out its own penalty. There is scarcely anything more obnoxious to a driver than to be stalled on his work by a broken down or defective machine. My experience has been that the men always are extremely desirous of having a well-working machine at all times, and very soon learn that carefulness is well rewarded in the operation of their machines. Discussion of any apparent carelessness, the awakening and maintaining of interest in the men as

to the appearance and make-up of machines, together with their own comfort and good interests, has proven sufficient for us to get the desired results.

Page 1048, Last Paragraph: The arbitrary figure of 6 cents per mile, I assume, does not include depreciation, interest and insurance. With the three above items added, I should think the figure would be nearer 14 cents. If there were more than one driver to a machine, I cannot see who would pay for the breakage. During sickness or other absence, the machine surely cannot remain idle. When work so varies that one man would be taken from driving and, say, another machine breaks down, would this mean that the man removed from driving on account of slack work would again drive? And the man with the crippled machine take his place at other work? All men are not equally proficient in their work, and the work must needs suffer if this condition exists. Likewise, an undue amount of shifting of employees is thus necessitated.

Page 1049, point 3: I notice that responsibility for lubrication and inspection is safely placed on the driver. It seems that this would be entrusting much to comparative inexperience. Without the centralized supervision, there would be a most natural tendency under the bonus system, to side step "Safety First" and to run as long as possible without replacements, etc. With out present system in Philadelphia, the driver has no incentive other than to report even possible defects.

Page 1050: Ownership of machines by the men as outlined on this page, might readily lead to excessive oiling and care. In the summation of advantages, better care of motorcycles is first spoken of. This, in my estimation, is decidedly offset by inexperience. The second feature, "Less delay in getting orders through office for purchasing repairs," describes a condition that should not exist. The third item, "Minor repairs made with least expense to driver and loss of time to company," again I will call attention to the "Safety First" slogan. A minor defect not repaired properly may cost a man his life.

Page 1051: Blowing out services, especially the old ¾-inch,

with which we have the majority of stoppages, by the high pressure compression tank method, seems rather dangerous. Any meter, stove, incandescent wagon or complaint man can do this with a hand pump.

Page 1052: Reduction in unit cost of complaints handled, 28 per cent. This might be possible, but it all depends on what the cost was before the reduction. A few figures including transportation, etc., would be very interesting.

Motorcycles are fair-weather machines, and when practically all the working force is using them, its working capacity is cut down, at least, one-third under unfavorable weather conditions. You do not have sufficient men in bad weather, and with motorcycles, this is not limited to heavy snow as is the case with bicycles.

Page 1053: "For each order executed over fifty, an extra payment of 10 cents is allowed." This feature brings up all kinds of complications in my mind. It does not seem practical; with different districts, distances, C. G. I.'s (Can't Get In), etc., it seems almost impossible to figure out. Would an order where a very large meter entered into the work, taking probably five times as long to complete, be considered the same as a smaller job?

Advantage No. 1, which reads "Fewer men who were willing to make an extra effort, etc." really means, I should think, "Fewer men required to make extra effort, etc."

Advantage No. 2: "More speed in executing orders; better service, etc." This is a fair-weather condition only.

Advantage No. 3: "Reduced labor and unit costs." This appears to be O. K. if the distances are long, but in congested sections, I do not see much reduction in cost, especially where the orders are close. Again, I would like to ask if transportation cost is included in this unit cost, etc.

Page 1054: The feature of having trailers attached to trucks is a very interesting one. It seems to me much money could be saved by our company if such a method was adopted. Especially on delivery work, a trailer carrying the appliances and the truck the material, would without doubt, be very bene-

ficial. If Mr. Treadway could give a few figures showing what saving is accomplished by his small trailers, it might be very interesting.

Page 1055: "During the morning the greatest effort was applied to selling, etc." This practice seems very expensive from the selling and connecting point of view. The delivery cost is certainly very high.

Next Paragraph: "The fitter receives his regular hourly rate, but allowed no overtime. For each range delivered and connected over three a day, receives 50 cents." This seems rather unfair as so much depends on the salesman making sales, time of day, etc.

Results three and four state that "the unit cost of selling was reduced, also the unit cost of delivery and installation was likewise reduced." May I ask if handling and standing time was omitted and only the fitters' working time charged to delivery and connecting? If this was included, then I can only say in both cases as to cost—what was it before?

Page 1057: Writing the material used on the back of an order card does not seem practical. The fitter-salesman, likewise, does not seem practical. He is too rare an article.

Page 1058, Paragraph 2: In paying bonuses, it certainly should not, in any way, include the cost of material against cost limit. Even the cost of labor per $1.00 worth of material would be unfair, as some of the most difficult jobs require but a limited amount of material. It is also possible that material would be wasted if a bonus was given on this basis.

Paragraph 3: Why should a bonus made by a fitter be paid partly to the salesman?

In summing up my discussion, I should say the bonus system was not practical, especially for a city like Philadelphia. Any arrangement of paying men, whether it be by a bonus system or any other system, must be clearly understood by them to prevent prejudice. Cost per mile, cost per hour or life does not mean much with machines, as different classes of work, different districts, loads, etc., and with us, different

makes and classes of machines, would enter into the consideration.

Mr. E. P. Jones (Philadelphia): (Written discussion communicated.) 1. Automobile Delivery Bonus System. If all drivers started with new cars, the system as stated could be used with justice to the various drivers. Costs could, however, be adopted for each car and the system followed as stated. The drivers would undoubtedly be more careful in avoiding accidents, in noting slight troubles with the car, which if neglected would need more attention later on, and in the general running of the car.

2. Motorcycle Inspection. The ownership plan of the motorcycle, I believe, would work out advantageously as stated. I believe the repairs not made by the men themselves, should be made by the company's repair man. This would give a uniform quality of labor and material placed on the machines with better results than that obtained from outside mechanics.

3. Handling of Complaints. This complaint system is very similar to the one we employ. Where an important job is concerned, and it cannot be completed by the man, he telephones it to the shop where it is dispatched by telephone or inspector to a man equipped to complete the work.

4. Handling of On and Off Orders. Fifty orders a day to complete under our system is entirely too high, as this allows less than 11 minutes per job, which would not permit the proper execution of the work.

I am not in favor of a bonus system for extra work, as this is an incentive to the man to hurry through each job, and cases would be found where the work was not finished satisfactorily. Any system of checking these jobs would be expensive, and also would be apt to cause dissatisfaction among the men, due to the supposed favoritism shown by the inspector to certain men.

5. Sale and Installation of Gas Ranges. The success of this system depends on the sale of one type of range only, and

as to whether it would work out successfully in other situations, could be determined only by a trial. The bonus system apparently did not consider whether a stove line was in or not, which would result to the advantage of the fitter working in an old part of town, where the proportion of "lines in" would be high.

6. Sale and Installation of Tank Water Heaters. The 1915 system would be expensive due to loss of time, as a result of the uncertainty of the amount of work. The 1916 system is much better, but I believe the supervisor could take care of more than three fitters. The bonus system would be affected by the conditions stated under ranges.

7. Sale and Installation of Automatic Gas Water Heaters. I do not consider the bonus system applicable to this class of work, as there are so many varying conditions which arise in the work, to make uncertain the value of establishing a bonus before the work was started.. If a bonus system is to be attempted, a division of the saving between the inspector's labor estimate and actual labor costs of a job, might work out satisfactorily, if the inspector could be relied on to give a true estimate.

The paper would be more valuable for considering the merits of its system if the cost values for the various connections had been given; also the cost of the average amount of material used, and the wages of the men with the number of hours work per day.

Mr. J. P. Kennedy: I am interested to know whether in Philadelphia the motorcycle is used with side-car? I would like to know how Mr. Duncan handles that.

Mr. Duncan: In certain congested districts we use a motorcycle attached to the side-car in carrying incandescent lamps and fragile articles of that kind, light articles, but in the outlying districts where we have good roads, we use a Ford automobile.

Mr. Hall: I would like to ask how he issues his stock to his men, and if he makes any distinction between them, especially brass stock?

Mr. Duncan: We have a very elaborate system of issuing stock to the "incandescents," as we call them. We issue their stock and they return what they have not completed in the evening, the stock for all uncompleted orders is turned in again.

The Chairman: Mr. Treadway will close the discussion.

Mr. Treadway: Many of the criticisms imply that all our shop men are on bonus, while such is not the case. Our meter setters are not on bonus for the reason stated in the criticism, namely, the variable nature of the work. We try to get good men and pay them a good rate for this sort of work. In no case where we give bonus do they get a less hourly rate than before. We set a certain standard day's work; all work over this earns a bonus. The more work done, the greater the return. It is well known that overtime work is expensive. In our bonus system no overtime payments are allowed, but if overtime work is done, we know that we are getting value received, for we pay bonus on the actual work done and not on the hours put in. As far as having the salesman and fitter work together goes, it certainly is a radical departure from anything ever attempted that we know of, and it has proved to be as great a success as anything we have known of in the way of installing our appliances.

In 1914, we sold 2,569 gas ranges in the regular way. In 1915, a part of which year we worked under our new scheme, we sold by this plan 3,779, or 32 per cent. more. In 1916, we have sold so far 4,500, and the sales will reach 6,500 by the end of the year or more than 100 per cent. more than in 1914. That is partly because of the fact that we have furnished the means of getting the salesmen around faster and we are utilizing part of his time to help connect up the ranges. The two men work very well together. We have conducted a demon-

stration to see how long it would take to set up and connect a range just as it comes from the factory and it was done in 12 minutes. It can always be done in 20 minutes. We have found the same increase in sales with water heaters as with gas ranges and for the same reasons. It has been found that the shop cost of connecting up ranges is not so much less under the bonus system as it was before, but the total cost of selling and installing is very much less per range, and we attribute it partly to the fact that the salesman and the fitter tend to supervise each other and are both made more efficient.

Detroit is situated in such a way that every crew has a congested district and outlying district. The districts start at the river, where they are congested, and extend to the limits of the city, where they are not so congested.

The main thing I wish to bring out is that there are not so many men on bonus work, but those who are, are much pleased with it and they are earning more money than they did before. The plan gives us some very desirable jobs in the shop department and make an incentive for those who do not have them to do their work in such a way that they may be chosen for a desirable job at some future time. We pick the best men who are not on bonus to take a bonus job when there is a vacancy. We do this regardless of how good a man was in his former work, for we feel that our ends are better served when there is a feeling among the men that honest endeavor has a chance for reward.

The Chairman: The last paper on our program is by Mr. Charles Wilde, on "Oxy-Acetylene Welding." The paper will not be read, as it is already printed.

OXY-ACETYLENE WELDING IN DISTRIBUTION WORK.

Introduction.

Oxy-acetylene welding in distribution work is very rapidly taking its place as a means by which many things may be ac-

complished, which in the past have been considered almost impossible of realization. Of these, the absolutely gas tight welded main has been the greatest accomplishment.

The welded gas main is fast becoming the accepted practice, especially for the distribution of gas under high pressure, and is very rapidly displacing the old threaded joint.

The first welded gas main laid in this country was during the summer of 1911, since which time many miles have been laid, but as yet the practice is comparatively new to many distribution engineers, and to those who have adopted this method of making the pipe joints, many things are yet to be learned, each from the other, before a standard practice will be established.

As oxy-acetylene welding became better understood, the gas engineer was quick to perceive a much wider field for its use than was first thought possible, until to-day it is employed in service, shop, and repair work with equally as great success as it has been in new main work. It will, therefore, be the object of the writer to discuss briefly and enumerate some of the usages to which oxy-acetylene welding may be put in these various branches of distribution work.

Welded Mains.

There have been many excellent papers written in which the merits and advantages of welded gas mains have been set forth very conclusively. It will be the writer's object to endeavor to add some further knowledge which may be useful and to treat in this paper—in so far as it relates to new mains —on methods by which good results may be obtained with a minimum expenditure.

Many times the small details are not so thoroughly understood or appreciated, resulting in unsatisfactory work or in high cost. To illustrate this, consider an operator making a welded joint in which he is compelled to work in an uncomfortable position, resulting in slow work and very often an unsatisfactory joint. On the other hand, if he be working in a

comfortable position the weld will be made with no interruption for rest, resulting in better time, and a better weld.

Joints.

Of all the trouble in gas main work the joint has always given the most, and until the adoption of oxy-acetylene welding, the leaking joint was always present to a more or less degree. When welding was first considered in connection with high pressure distribution, it was not with the object of securing a cheaper joint, but with the possibilities it offered of securing a joint which would be absolutely gas tight, the cost being a secondary consideration.

The welded joint has two leading essentials, the first being that the joint should be made absolutely gas tight, and the second that the weld should have sufficient strength to stand all contraction strains. The first essential admits of no modification or variation; the second will, however, admit of considerable variation.

When the operator becomes proficient and thoroughly understands the conditions necessary in order to make a gas tight weld, very seldom will a joint be found that leaks. The thing to guard against in making a gas tight weld, is the porosity of the metal due to its being over-heated. The sign which will tell the operator of the foregoing condition is the boiling or globules which will show in the molten metal. The object to be attained is to bring the metal of the two ends of the pipe and the metal being added, to a point in temperature that will just make the molten metal run together in one mass. When bringing the metal to the necessary molten state, the operator should be constantly moving his torch from one side to the other in order that the flame will be constantly coming in contact with both ends of the pipe, and at the same time the rod of filling metal should be held in contact with the flame. This motion of the torch will be at the rate of about forty or fifty complete movements per minute if the proper size tip is used.

An important point which should not be overlooked in making a weld is to have a thorough knowledge of the proper size tip which should be employed for good results. The tip which should be used is the one that will bring the metal of the pipe and the filling metal to a welding temperature in the shortest possible time, and yet not so quickly that it would not permit of a thoroughly homogeneous weld being made. For good work the following practice seems to give the best results: For small mains up to and including 2 inches, a No. 6 tip should be used; for mains from 3 inches to 4 inches, a No. 7 tip; and for mains larger than 4 inches, a No. 8 tip should be used.

To illustrate to what degree of efficiency a welder may attain by thoroughly understanding his work and following out the principles necessary to make a good weld, it will only be necessary to give the experience of one of our foremen. On the first job which he laid with welded joints—and one on which he did all the welding under instructions—he had nineteen leaking joints out of twenty-three made. This somewhat discouraged him, but during the summer of 1914, this same foreman laid, in one operation, 2,000 feet of 3-inch, 10,000 feet of 2-inch, and 3,000 feet of 1½-inch pipe, without having a single leak at the welds. During the past spring, on an 8-inch extension on which from three to five welders were constantly at work, in four miles only four very slight leaks developed under a test pressure of sixty pounds.

Another and very important point to be observed in making a welded pipe joint is shown in Fig. 1, in which the operator is shown on one side of the pipe being welded and having the pipe turned away from him. By working in this way and having the pipe turned away from him, the operator will be able to weld just off and away from the side of the pipe on which he is sitting. When working in this position the molten metal will have a tendency to come in contact with the hot metal of the weld ahead, rather than with the cold metal to the rear of the point of welding and will contribute to making a good weld.

FIG. 1—Proper position for operator when welding a turning joint.

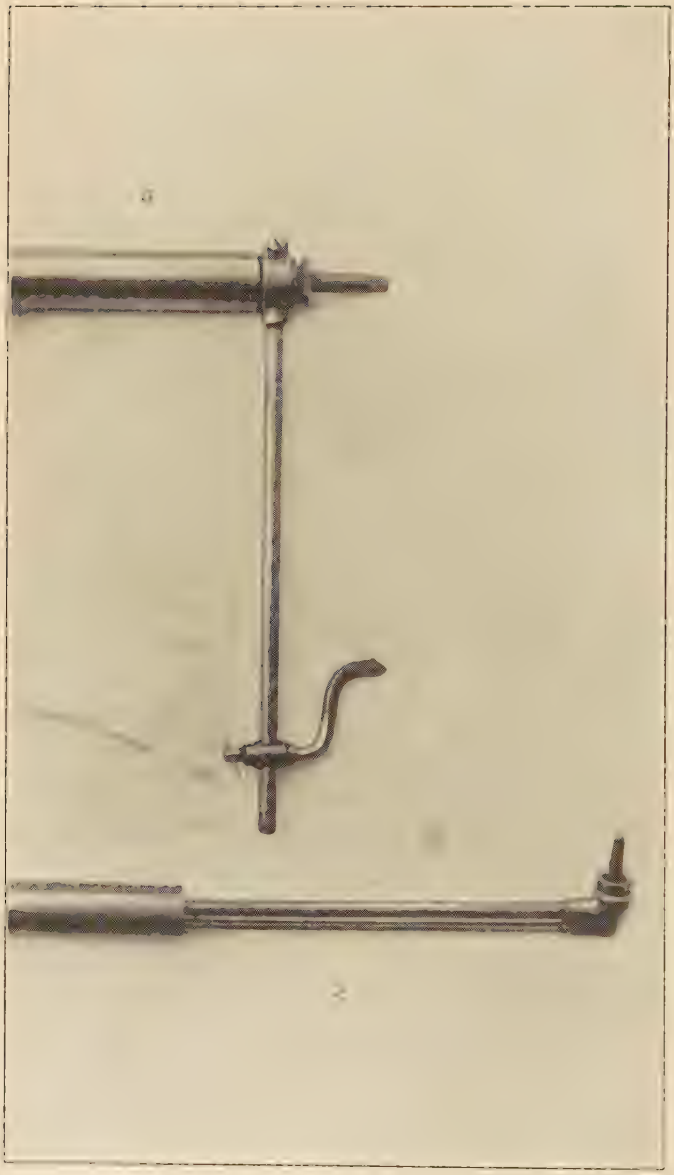


FIG. 2.—"A", Welding torch. "B", Machine cutting torch with circular attachment.

Fig. 2 (*A*) shows the style torch which has been found to be best suited for welding gas mains. It will be seen that this torch has a 90 degree head with straight rear connections. This torch will permit of the operator getting at the point in the circumference of the pipe where he desires to weld, whether it be on the under side of a ditch joint or on the upper side of a turning joint, with the least possible inconvenience.

Ditch, Stationary, and Turning Joints.

In order to distinguish the conditions under which a joint is made and for comparative purposes, they will be divided into three classes and will be termed "Ditch," "Stationary," and "Turning." The ditch joint, it will be understood, is the one made in the ditch; the stationary joint, the one made above the ditch but without turning the pipe; the turning joint, which is made with the pipe being turned in order to bring the point being welded to the most convenient position for the operator.

The ditch joint will take from two to three times as long, and the stationary joint generally about twice as long as it does to make the turning joint. On this account they should be avoided where possible.

The ditch joint should never be made only at points where it is absolutely necessary in order to make a connection when some obstruction makes it the only one that can be used. Fig. 3 shows one of these joints being made and very clearly shows the uncomfortable position in which the operator is compelled to work. This, and the fact that a weld made on the under side of the pipe, even when made under the most favorable conditions, will take much longer to make than when made on the upper side, are the chief contributing causes to the length of time required on this joint.

The stationary joint cannot be entirely dispensed with under any circumstance, as it is required at every point where long sections of the pipe are being connected together, or at any

FIG. 3.—The ditch point showing the uncomfortable position in which the operator is compelled to work

point where a valve or drip is being placed. It was at first thought that this joint could be almost dispensed with by twisting the pipe to one side and then to the other, thus enabling the weld to be made on the sides and top of the pipe. However, this has been found to be impracticable and would, if it were possible to do so, require so many men to twist the pipe that it would far exceed in cost the same joint when made stationary. The number of such joints can, however, be kept to a very small proportion of the whole number required by welding the pipe in as long sections as it is possible to handle.

The turning joint is the most economical to make and on this account the number should be kept to a maximum. Fig. 1 shows very clearly the comfortable position in which the welder works in making this joint and which contributes very materially to the speed by which it can be made. The principal contributing factor in making this the quickest and most economical joint, is the fact that the whole weld is made at the point in the circumference of the pipe best suited to quick welding.

Further considering the joint from the standpoint of strength it will be found that it may be made perfectly gas tight, and yet may be made so light that it would lack the necessary strength which a pipe weld should possess. On the other hand, the joint may be built up unnecessarily, making an entirely too heavy and wasteful joint. A joint in which the weld is built up just slightly above the thickness of the pipe is the joint which the operator should aim to make. Such a weld will equal, if not exceed, the tensile strength of the pipe itself.

In the following figures, which are photographs of 8-inch joints, the object will be to bring out in as clear a manner as possible the above points.

Fig. 4 shows a welded joint which has not been made sufficiently strong and should not be permitted. It will be noted

FIG. 4.—Light weld. Showing a welded joint which has not been made sufficiently strong.

by a careful study of this particular joint that the metal added (which was about 7 ounces) to fill the V formed by the two chamfered ends of the pipe coming together, had not been sufficient to fill this space to the thickness of the pipe itself, thus resulting in a welded joint possessing considerably less strength than that of the pipe.

Fig. 5 shows the other extreme, an unnecessarily heavy joint which will have a tensile strength considerably in excess of that of the pipe, and requires about 13 ounces of metal to make it. By a careful study of this figure it will be noted that the joint has been built up until it is considerably thicker than the walls of the pipe. A joint made as this one is should be avoided, owing principally to the waste of material.

Fig. 6 shows a welded joint which is one made to about the proper weight and is a good weld in every respect. The weight of the metal added (about 10 ounces) is sufficient to build the weld slightly thicker than the pipe walls, and at the same time allow an even distribution over the entire joint. It will be noted how evenly this weld is made, the width being about ¾ inch, and is made to almost a perfect line around the full circumference of the pipe. A joint made as this one is possesses all the qualifications of strength and tightness necessary to a good joint, and is about what is desired for good work.

Considering these three typical individual joints from the standpoint of their relative cost, but which, however, must not be taken for the average cost of such joints, we find that the light joint cost 89 cents. For the heavy weld the cost was $1.13, and for the medium or desirable joint, the cost was $1.00. Thus it will be seen that the difference of cost between the very light joint and the very heavy joint is 24 cents, or a difference in cost per foot (when 20-foot lengths are being laid) of 1.2 cents; when 40-foot lengths are being used, a difference of 0.6 cents per foot. In the case of the medium joint the difference of cost with respect to the light weld will be 11 cents, or 0.55 cents per foot when using the 20-foot lengths, and 0.275 cents when using the 40-foot lengths.

FIG 5.—Heavy weld. An unnecessarily heavy joint which will have a tensile strength considerably in excess of the pipe.

FIG. 6.—Ideal weld. Showing a welded joint which is made to about the proper weight.

When these small differences of cost per foot of main laid are considered, it is at once evident that no one should, in an effort to economize, lay a gas main with a joint or joints so light that there might be danger of a break from contraction. The writer does not hesitate to say that it would be far better and cheaper in the end to lay a main with all the joints made with a little too much metal than to have a few made with insufficient metal.

Cost Data.

In considering the cost of the welded joint and in order that an intelligent understanding may be arrived at, it will be the object of the writer to discuss this subject from every possible angle, hoping to give the reader information which will be of the greatest value as a guide to economical work.

In order to bring out all points of cost clearly, it will be given first, for the actual cost covering the exact time required to make the joint; secondly, for the average total time of the operator and helper for welding and adjusting the pipe; thirdly, for the total time of operator and helper plus the necessary extra help for lining up the pipe ahead of the welding. In order to arrive at a clear understanding the ditch, stationary, and turning joints will be considered separately.

The turning joint, being the most economical and the one that should be used as much as possible, will first be considered. An 8-inch turning welded joint may be made in some instances in twenty minutes, or it may take as long as thirty-five minutes, and yet there would be no difference in strength or in its quality as a gas tight joint. This difference of time may be caused either by the chamfer on the ends of the pipe being very uneven, or possibly due to one or the other of the ends of the pipe which is being welded, having for a portion of its circumference an extra thickness of metal.

First considering an average joint, and taking into consideration only the actual time necessary to make it, the cost will be:

Labor (including operator and helper)	$0.23
Acetylene	.38
Oxygen	.42
Filling iron	.07
Total cost per joint	$1.10

or a total cost per foot of pipe laid (20-foot lengths) of 5.5 cents.

The above cost being only for the actual time found necessary to make the joint, it will be obvious that in order to arrive at a more clear understanding of the cost of the weld, the full cost of the operator and helper in other work, such as setting the pipe for the joint, changing tanks, etc., necessary in connection with the actual welding, should be added. This additional charge will increase the labor cost from 23 cents to 41 cents, making the total cost of the joint $1.28, and the cost per foot of main laid, 6.4 cents.

Still further considering the cost in addition to the labor cost necessary for the actual welding, add the labor cost found necessary when laying a main of the size being considered (8 inches), to place the pipe in position for the welder and helper it will be found that there will be an additional labor cost of 18 cents per joint, making the total cost of the joint $1.47, or a cost per foot of main laid of 7.3 cents.

The above costs were calculated from 327 joints made by three welders working ahead of the ditch.

Considering now the ditch and stationary joints, we would find if the maximum cost of these were taken, that in some instances they would be as high as three times that of the turning joint, depending upon the condition under which it is found necessary for the operator to work. First, considering the ditch joint, we find that the average cost will be about as follows:

Labor	$0.45
Acetylene	1.06
Oxygen	1.20
Filling iron	.10
Total cost per joint	$2.81

The stationary joint will be found to cost somewhat less than the above and will average about as follows:

Labor	$0.30
Acetylene	.84
Oxygen	.96
Filling iron	.10
Total cost per joint	$2.20

From a careful study of these figures it will be at once apparent that every effort should be made to avoid these latter joints, as already shown, whenever possible. The joint in the ditch should only be resorted to when an obstruction compels its use. It will be found in the case of the stationary joint that an average of about fourteen will be required for each mile of main laid. If good judgment is used and these expensive joints kept to a minimum, the average cost per joint or per foot of main laid will only be slightly increased.

Twenty- Versus Forty-Foot Lengths.

Some engineers have thought that the extra cost of labor for handling the 40-foot lengths of pipe would more than offset any saving which might be effected due to the reduction in the number of joints made per foot of main laid.

In order to arrive at an intelligent understanding on this subject, the average cost of 128 joints or practically a mile of 8-inch main, using 40-foot lengths, was calculated. The average cost, including all labor necessary, in addition to the operator and helper, for shifting the pipe ahead of the welders, showed as follows:

Labor	$0.95
Acetylene	.38
Oxygen	.42
Welding iron	.07
Total cost per joint	$1.82
Total cost per foot of pipe laid	$0.045

Thus it will be seen by a reference to the maximum cost of a joint made when using 20-foot lengths under the same conditions, the cost will be 35 cents less than the joint of the 40-foot lengths, but that the latter has a much less cost per foot of main laid, the difference in favor of the long lengths being 2.8 cents. These figures, however, do not take into account the possible extra cost due to cartage, which would probably decrease the difference per foot in favor of the 40-foot lengths to about 2.3 cents.

The foregoing analyses of costs being all for 8-inch joints, it might be of interest to have, as a guide in order to arrive at the cost of mains of sizes from 1½ inches up, the actual cost of making the joints in the smaller sized pipe.

TABLE I.—Cost to Weld Joints.

Test No.	Size of pipe	Size of tip	Time to make weld	Acetylene consumed	Oxygen consumed	Filling iron used	Cost of weld
1	1½″	6	3 minutes	1.25 cu. ft.	1.5 cu. ft.	0.9 ounces	$0.08
2	1½″	6	2 "	1.0 " "	1.0 " "	0.8 "	0.06
3	2″	6	5 "	2.0 " "	2.25 " "	1.1 "	0.13
4	2″	6	3 "	1.25 " "	1.5 " "	1.0 "	0.10
5	3″	6	7½ "	3.0 " "	2.5 " "	2.45 "	0.19

Table 1 shows these costs arrived at from tests made on joints from 1½ inches to 3 inches. The actual time to make 4-inch and 6-inch joints would be about 14 and 20 minutes, respectively; and the cost would be about 55 cents for the 4-inch and 70 cents for the 6-inch.

These tests show only the cost of labor actually required to make the joint, the costs, including all other necessary labor in

connection with the weld, will be governed by the efficiency of the organization.

Connecting Long Sections of Pipe.

The pipe having been put together in long sections by making turning joints, it then becomes necessary to bring the sections of pipe—which in some instances may be 500 feet long—together in order that they may be jointed to make the continuous main.

This may be accomplished by either one of two ways, namely by shifting the pipe on rollers or by having each one of the sections, as put together, to slightly overlap, and cut off the portion of pipe which overlaps and then bring together and weld.

This latter method of bringing the ends of the long sections of pipe together will require no shifting of the pipe and will, therefore, require a minimum of labor. The pipe which is to be cut off should be marked very accurately around the full circumference of the pipe with something which will make a distinct line in order that the operator may be guided when cutting the pipe. An 8-inch pipe can be cut with the cutting torch in from two to three minutes, and will, by following the line marked on the pipe, be as straight as could be made in any other way.

The method of shifting either backward or forward can be done by the employment of rollers mounted on blocks. The pipe being placed on the rollers can be very readily shifted by attaching an automobile to the pipe by means of a rope.

A method of shifting sections of pipe in streets where a great number of obstructions are encountered, is shown in Mr. D. J. Young's paper. See bibliography.

Making Connection to Existing Main When Valve Leaks.

It many times develops when making a connection to an existing gas main for a continuation of the same, that the valve will be found leaking, thus making what would appear

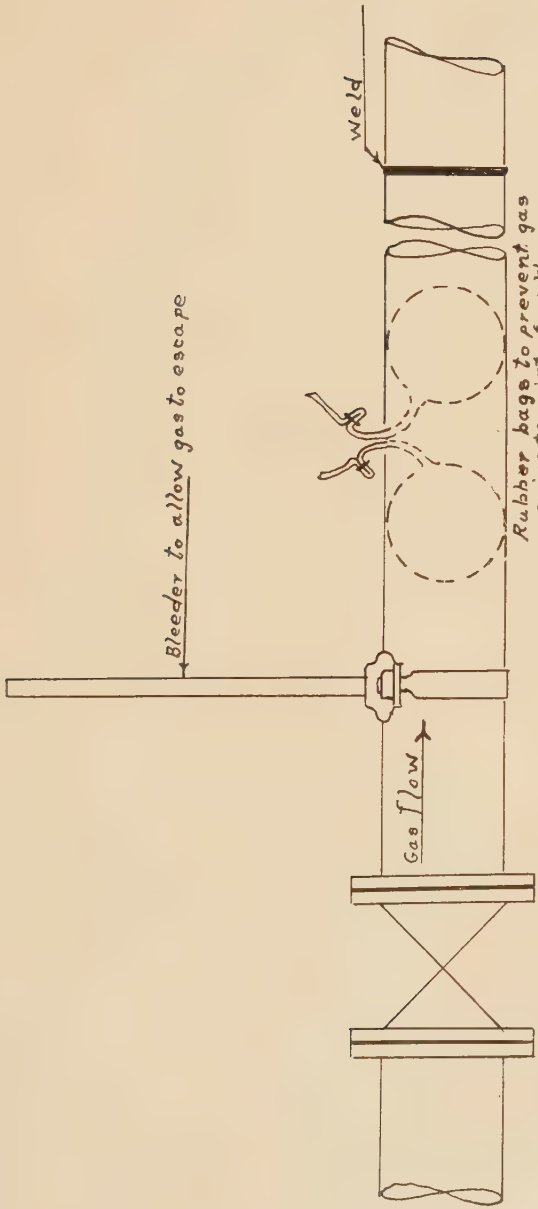


FIG. 7.—Method of making connection to existing main when valve leaks.

to be a condition which would make a welded joint for the connection impossible.

Fig. 7 shows in detail a method by which the work under this condition may be made a comparatively easy and safe undertaking. The method as shown consists in nothing more or less than the bagging of the main and tapping it between the points of the bags and valve and extending therefrom a bleeder above the ditch, in order that the gas leaking through the valve may be carried off and thus be kept at a pressure which the bags will withstand. This is a very simple and efficient method and has been very successfully used in overcoming this difficulty, not only for new main work, but for repairs when it is found necessary to shut off the gas.

Flanges.

The companion flanges for connecting the valves in a main should be welded to short pieces or lengths of pipe in advance of the actual main work.

Flanges may be made by the use of the machine cutting torch, with circular attachment, for any size pipe and will be considerably cheaper than the ordinary extra heavy forged steel flange. When the flanges are cut from plate the opening should be cut sufficiently large to just allow the pipe to slip in.

To weld the flange to the pipe the pipe should be slipped in the opening just far enough that the pipe will not come to the face of the flange, and peened. The two to be then welded with the weld of sufficient strength to withstand any contraction strain which may take place at these points. When the flanges used are made from steel plate there will be no difficulty experienced with those of sizes up to and including 4 inches. For sizes larger, however, difficulty may be experienced owing to the possibility of the flanges being slightly warped, due to the heat from the torch. Before sending these flanges out to be used they should be very carefully inspected, and, if found necessary, be refaced in order to avoid any difficulty from this source. If the extra heavy forged steel flanges are used, the same difficulty may be experienced from

warping as the result of the heat, and the same precautions should be taken to avoid trouble.

Another precaution to be observed if the threaded forged steel flange is to be used, is that the weld should be made to entirely cover the threads in the pipe and thus bring the pipe at the point of the weld to the full tensile strength of the pipe.

The cost of the flanges cut from steel plate, using an 8-inch size for comparison, would be, for all labor and material, about $4.75 against $7.00 for the forged steel.

Drips.

Fig. 8 shows a drip designed on the same principles as the standard line drip as used in low pressure mains. This drip has been adopted in order to secure a maximum of capacity in as small a space as possible.

The riser is the point to which it is desired to call particular attention. This riser is perfectly straight, as is the case with the low pressure drip riser, thus reducing the threaded joints to a minimum. Another consideration for the straight riser is the comparative ease with which it may be renewed.

The drips as generally constructed for high pressure mains have been with the blow-off or riser brought from the under side of the drip. A blow-off thus constructed made it necessary to place a cock at the junction of the blow-off with the drip proper in order that in case of a leak the gas could be shut off. The riser coming from the under side of the drip also seems to be a point more often affected by corrosion than at any other point; especially is this so if electrolytic conditions are bad.

Making a Lateral Connection.

When oxy-acetylene welding was first proven to be a success for gas main joints, it was not thought possible that a connection could be made for a lateral main only at such time when the new main was being laid; also that all connections should be provided at any point where a lateral main would be required of any size from 2 inches up, and for the

small sizes using a saddle and cock and tapping through the cock at the time lateral connection was required.

FIG. 8.—Welded high pressure line drip.

However, with the better understanding of the possibilities of oxy acetylene welding, and having proven that a connection

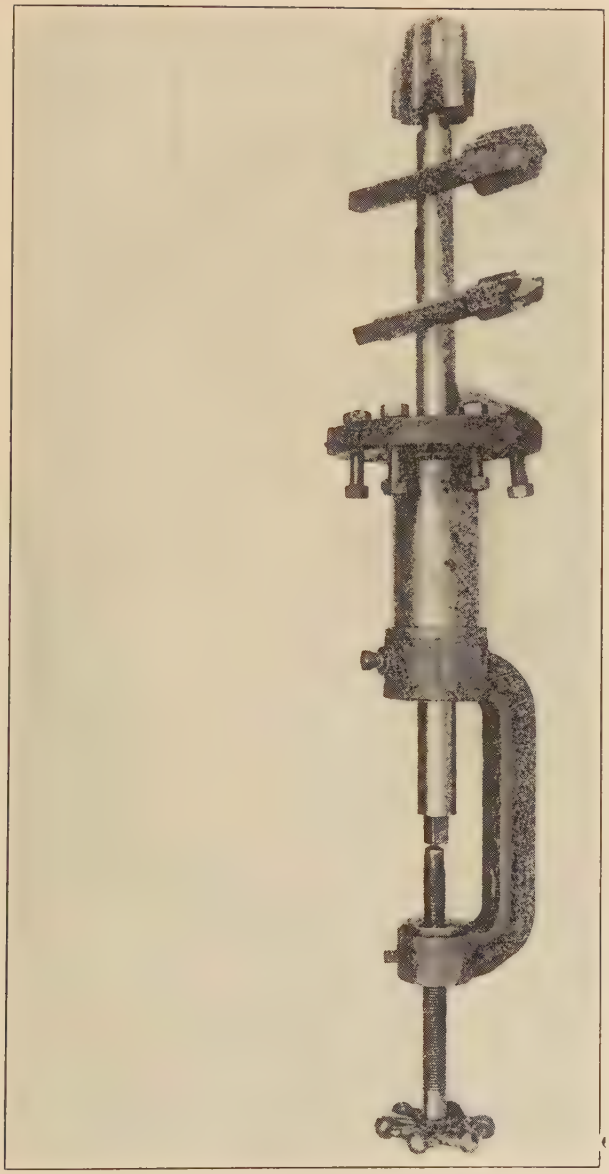


FIG. 9.—Drilling machine with drills 1¼″, 2″, and 3″ for lateral main connections.

could be made with any pressure of gas maintained in the main, the necessity for providing any such lateral connections was seen to be unnecessary. In order to make the connections, made under pressure, entirely satisfactory, it was found necessary to have a drilling machine constructed which would drill the main for any size opening up to 3 inches in diameter.

Fig. 9 shows a drilling machine, with low pressure taps from 1¼ inches to 3 inches. These taps, it should be noted, are only used as drills, and should as such be considered. It will also be noted that the flange to which the stuffing box is attached is drilled to match a 2-, 3-, or 4-inch flange, thus enabling it to be attached to any size valve up to and including 4 inches. This drilling machine was specially constructed for this class of work.

Fig. 10 shows a 2-inch welded connection being tested to prove that the joint at the main is absolutely tight, which should be done before the main is drilled. Unfortunately, the photographer obtained this picture before the pressure had been pumped up, as it will be seen that the gauge registers 0. The pressure used in the test of this joint, however, was 50 pounds.

Fig. 11 shows the drilling machine in place and the main being tapped through the valve.

All that is necessary in making a connection under pressure, as shown in the above figures, is to weld to the main a short piece of pipe of the proper size, to which a flange has been previously welded. To the flange thus provided, attach the valve. To the outlet of the valve attach a suitable connection in order that the joint at the main may be tested. After testing and proving that the joint is tight, drill the main through the valve. After the main has been drilled draw the drill past the valve gate, close valve, and remove the drill and drilling machine from the valve.

In Fig. 10 the testing is shown as being done by an ordinary hand pump. It may be tested, however, more quickly—if suitable fittings are at hand—by attaching the oxygen or acetylene tank to the valve and turning the pressure from the

FIG. 10.—Testing a welded connection.

FIG. 11.—Drilling for a 2-inch lateral.

tanks into the valve and connection. The only expense, aside from making the connection for the test, is the amount of oxygen or acetylene used, which would be very small.

Note the ¼-inch steel rod standing from the main just to the left of the connection. At the point of this rod there had been a temporary saddle connection to supply the lateral line. This was removed and the opening welded with the use of the rod as shown. The method of dispensing with saddle connections will be fully discussed and illustrated under "Repair Work."

The time to weld the 2-inch connection to the main was one and a half hours, and the time required to drill the main was twenty minutes. The total cost of the connection, including the short piece of pipe and flange—the latter being cut out of ½-inch boiler plate and welded to the pipe in the shop—was $3.80.

When making a connection as shown above, if it be a 3-inch connection to a 3-inch main, or a 4-inch connection to a 4-inch main, or in fact any connection which is the same size or only one size smaller than the main to which connection is being made, great care should be exercised in drilling the main in order that it will not come in contact with, or cut into, the opposite wall inside of the main being drilled. The necessity of this precaution will readily be seen when it is realized that when making a 3- or 4-inch connection to the same size main, the drill will have penetrated well through the diameter of the pipe before the full opening is made.

For tapping mains from 2 inches to 4 inches, inclusive, the following size drills should be used: 1¼-inch for 2-inch main, 2-inch for 3-inch main, 3-inch for 4-inch main.

The tapping machine as shown, which was made up from designs prepared by our Superintendent of Distribution, cost $49.83, complete.

Pipe Bending.

Bending the pipe cold as the bends are required when laying a main is a very simple matter for any size pipe up to and

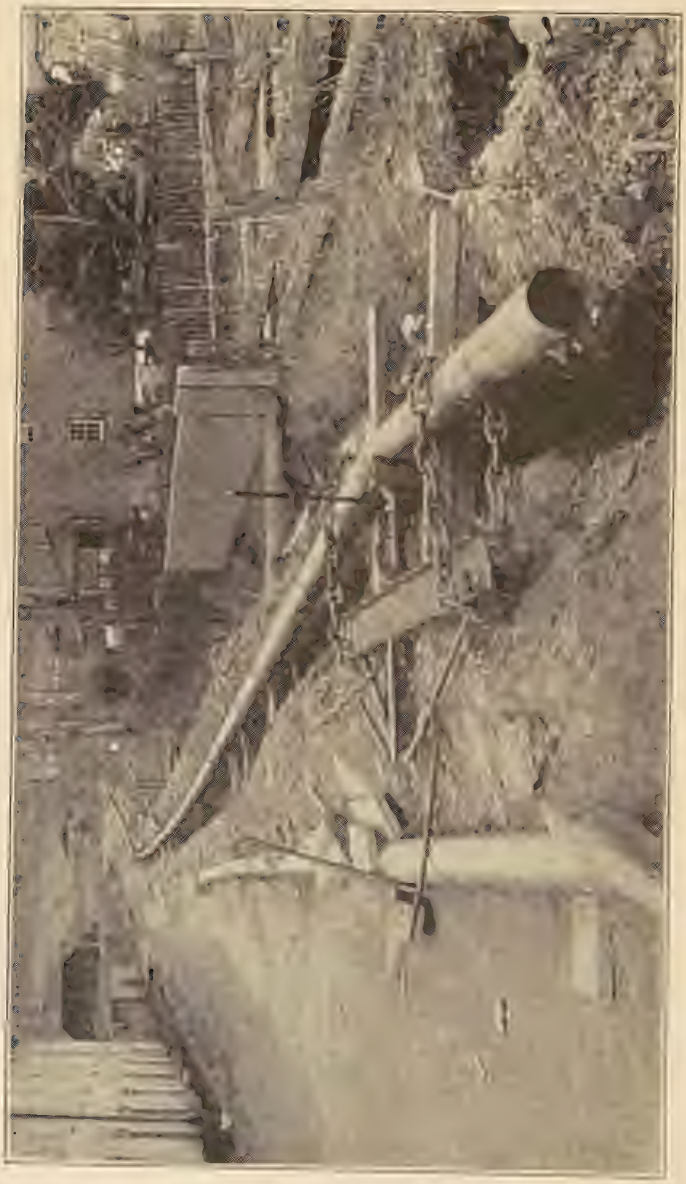


FIG. 12.—Bending machine for large sized pipe

including 4 inches, but with any sizes above this the bending becomes a very serious matter, especially when it is required at points of considerable travel or where no convenient means can be found to attach the usual block and fall.

Fig. 12 shows a bending machine which has proven to be of the greatest assistance in laying 8-inch pipe. The machine is a very simple arrangement, consisting of a 10-inch I beam, 10 feet long, braced with 1¼-inch tie rod, two ¾-inch chains 8 feet long, and an ordinary 20-ton screw jack and block.

The operation of this machine is quite simple and requires only a minimum of labor. To operate, all that is necessary is to link the chains around the pipe and I-beam by means of a slip link, place the jack and pipe block in position between the pipe and the beam, then by the force of the jack, make the bend. If the bend required is only a slight one, it may be made without any shift of the machine. If it be a bend of any considerable extent, the machine should be shifted one way or the other, bending the pipe a few degrees until the required bend is made.

With this machine four men can make a bend in an 8-inch pipe, depending, of course, upon the radius and degree of the bend required, in from a half to two and a half hours, or a labor cost of from fifty cents to two dollars and fifty cents per bend.

To make the same bend—when possible to be made in the old way—would require about twenty-five men, who would never lose less than half an hour from their regular work, which would mean a minimum cost of three dollars and thirteen cents ($3.13), and would often require twice this time, resulting in a labor cost of six dollars and twenty-six cents ($6.26).

In addition to the saving in labor cost, another and very great advantage of an outfit such as described above, is that the bends may be made in advance of the actual main laying, thus assisting very materially in the progress of the work.

Fig. 13 shows a very long bend made by the above machine and brings out clearly its advantages. This bend was made

FIG. 13—Long bend made with bending machine.

in sections, afterward welding the sections together over the ditch as shown.

Services.

In high pressure service work the greatest trouble experienced has always been at the connection to the main. The connection, which has generally been accepted as good practice, has been the one made with a saddle, corporation cock, and swing joint. The weak points in this style connection are the saddle and the great number of threaded joints required.

When oxy-acetylene welding first became the practice in main work it was at first thought that the only time that a service connection could be welded to the main would be those made to a new main in advance of the gas being turned on. It was not long, however, before it was proven that the service connection could be made with absolute safety to any existing main regardless of the gas pressure. Tests illustrating this point were shown and discussed in Mr. J. D. Shattuck's paper. See bibliography.

When the fact was established that service connections could be welded under any pressure conditions, it was seen that the saddle could be entirely dispensed with. Later, it was suggested as a further step in the direction of an absolutely leak proof connection free from the possibility of any future trouble, to use a welded tee piece, thus reducing the threaded joints to one. Fig. 14 shows a connection with a tee piece being welded to the main, and Fig. 15 shows the tee piece in detail.

The manner of making this connection is first to weld the connection to the main, extend the service to the curb and set the curb cock, which should be left open. Drill the main through the tee piece with a ¼-inch drill; remove the drill and screw the cap on the open end of tee, and close curb cock. The curb cock is left open in order that the gas may pass out through the service pipe, thus enabling the cap to be screwed on the tee with comparative ease and safety. The tee pieces as shown in Fig. 15 should be made in the shop at

FIG. 14.—Making a welded service connection with gas in the main.

times when the weather conditions will not permit any outside work, and placed in the storeroom and taken out as required.

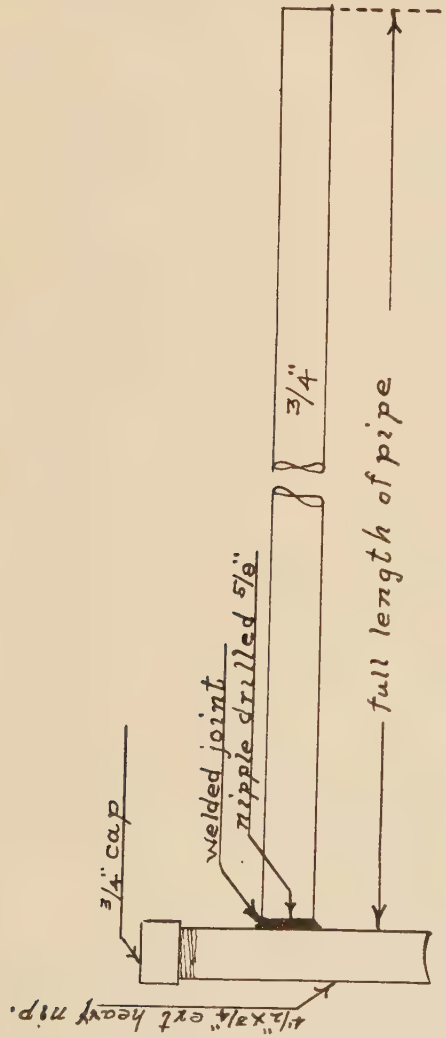


FIG. 15.—Welded tee piece for service connection.

The average cost of making this connection to the main, including all labor and material, is about 55 cents, and this cost will not vary from the smallest to the largest sized mains.

Comparing this cost with the cost when made with a saddle and cock, it will be seen at once that the welded connection possesses the advantage of low cost as well as that of strength, durability, and freedom from leaks.

The comparative cost of the welded connection with that of the connection when made with a saddle and cock, and with the saddle when no cock is used, is shown in Table II.

TABLE II.—Relative Cost of Service Connections.

Size	1¼″	1½″	2″	2½″	3″	3½″	4″	6″	7″	8″	10″
Welded	.55	.55	.55	.55	.55	.55	.55	.55	.55	.55	.55
Saddle without cock	.42	.45	.47	.49	.51	.64	.66	.79	1.05	1.11	1.67
Saddle with cock	.87	.90	.92	.94	.96	1.09	1.11	1.24	1.50	1.56	2.12

By an examination of the table it will be seen that the cost of the saddle connection rises rapidly with each increase in the size of the main.

It might be thought that a connection made in this manner would be too rigid and would be in danger of breaking at the main. Fig. 25 shows the extension part of the welded tee pulled to one side in order to subject it to a strength test, thus placing a strain upon it far in excess of any to which it would be subjected in actual practice. This proves conclusively that there need be no fear as to its strength and durability. Note the bend in the pipe near the body of the tee.

Shop Work.

The use of oxy-acetylene welding in shop work has proven to be of greatest assistance in the work of the distribution department. By its use many repairs are made which would otherwise be impossible; many times by its use, some apparatus —such as a special burner—is made better and more economical than by any other way. But in no way does the value of the welding torch show to better advantage in shop work than in that of preparing material for a proposed main extension, or in fact, for any work for which material may be prepared in advance.

For any proposed main all the drips may be made and

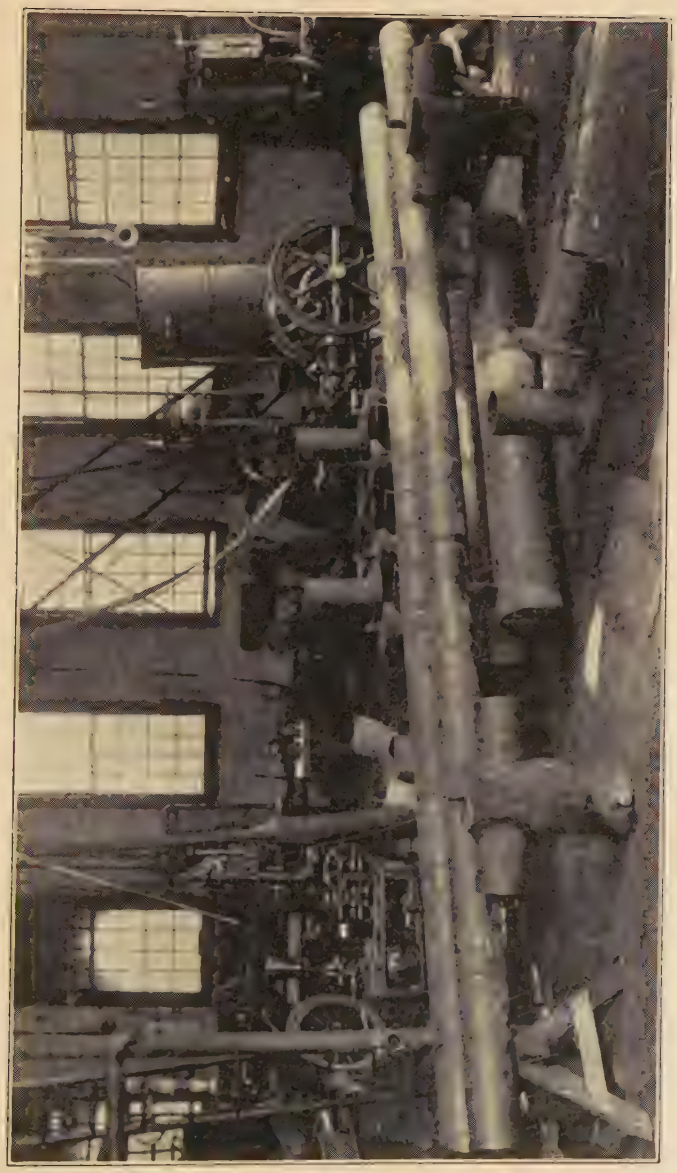


FIG. 16.—Drips and flange pieces made ready for proposed main.

tested in the shop, and likewise, all the companion flange pieces may also be prepared in advance of the actual work in the field. When it is considered that one 8-inch drip will require as much welding as about five 8-inch joints, the saving of time when laying the main will be thoroughly appreciated.

Fig. 16 shows a collection of drips and flange pieces made ready for a proposed main. The two large drips shown are for two points where the main will cross creeks. The other drips, which are made on the lines of an ordinary low pressure line drip, are for use at all other low points.

Fig. 2 (*B*) shows a machine cutting torch with circular attachment. This torch is extremely useful in shop work and almost indispensable when accurate circular cutting is required. With this torch a 6-inch opening, or in other words, 19 inches of metal 0.375 inches thick may be cut in from two to three minutes and be cut in a perfectly true circle. The circular attachment, which may be seen attached to the side of the torch and which may be set to any desired radius up to the length of the arm, enables the operator to do this perfect work.

Fig. 17 shows the operator cutting a 6-inch opening with the above torch in a 12-inch pipe. In Fig. 18 the operator is again shown cutting a circular piece from a ½-inch boiler plate. Note the perfect circular opening in the 12-inch pipe which is shown being cut in the former figure; also note the perfect circular pieces which have been cut and are standing against the tanks. The parts shown being prepared in this picture are to be used in making up the large drips shown in Fig. 16.

Fig. 19 shows a very pretty installation which was made up in the shop, ready to be placed where it is shown. This shows a governor and meter installation as neatly put together and occupying a minimum amount of space, as it is possible to make it. The manifold of this installation is welded throughout, and was made to accommodate four 30-light B meters and two No. 4 equitable governors. When making this manifold the two legs and cross pieces were welded together, after which

FIG. 17.—Cutting a 6 in. opening in a 12 in. pipe with the machine cutting torch

FIG. 18. Cutting a circular piece from ½ in. boiler plate with machine cutting torch.

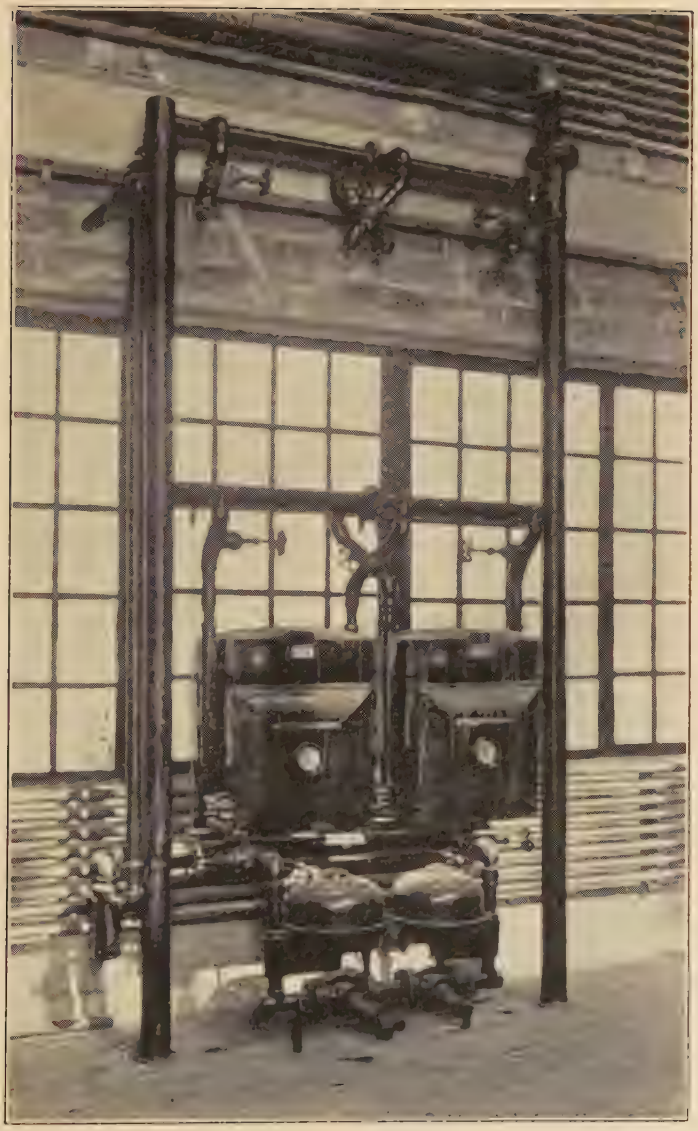


FIG. 19.—Welded meter and governor installation.

the two cross pieces were cut at exactly the middle point and to these ends blank flanges, made of ½-inch boiler plate, were welded. With these flanges the two sides were bolted together again, thus making on the left the inlet, and on the right the outlet for the meters. By welding the manifold all in one and then cutting the cross pieces and bringing together with blank flanges, assures a more perfect alignment of the two sides than could be obtained otherwise.

The example of shop work shown in the above figures are only a few of the many uses to which the welding and cutting torches may be applied in the shop. It will be found that almost daily some required repair or other necessary work can be done, generally cheaper, and always better, than by any other means.

Repair Work.

Oxy-acetylene welding in repair work has been least understood, and as far as the writer knows, has never been treated in any paper on welding in this country, although the field for its use in this way is practically unlimited, with new ideas being suggested almost daily.

Welding in repair work requires more skill and more careful supervision, and offers a much wider field of opportunity for usefulness than in any other line of work in which it is employed, thus making it a subject of more than ordinary interest. The knowledge also that the repair when made will be an absolutely satisfactory one, and as permanently leak proof as the main itself, makes this mode of repair of the greatest satisfaction.

The following practices will not be given for the purpose of proving a cheaper method, but with the desire of giving the best way by which a permanent repair may be made. However, the costs will be given, which in very few cases, will show a cost that exceeds that of the old methods.

Covering an Expansion Joint.

Fig. 20 shows one of the most interesting and at the same time one of the most desirable methods of making a repair,

FIG. 20.—Welding a cover over an expansion joint.

when by any other method, it would require the gas being shut off with the resulting great inconvenience to possibly hundreds of consumers. The figure shows an expansion joint cover being placed over a leaking coupling, the cover used being the one the details of which were given in Mr. J. D. Shattuck's paper, previously referred to. See bibliography.

The method of placing this cover over a joint is to first cover the joint with sheet asbestos, as a precaution against the heat of the flame, and thus protect the rubber gaskets. Place the halves of the cover over the joint in a position so that one longitudinal joint is on the upper side. After welding this joint, for convenience and in order to facilitate the work, turn the cover so that the other longitudinal joint will be on the upper side. After these joints are made the ends are caulked with welding iron. From an opening which has been provided in the cover a vent pipe is extended for some feet above the ditch, this being for the purpose of carrying off any gas which may escape into the cover. The caulking of the ends of the cover, and the use of the vent pipe are precautions against the possibility of a leak developing in the expansion coupling, after which the end joints are welded.

The expansion coupling which was covered as shown in Fig. 20 was a peculiarly difficult one, it being one of those couplings with cast iron rings. The cause of the trouble in this case was not the rubber gaskets which usually give the trouble, but was due to the fact that one of the cast iron rings was broken in two places, the resulting leak being, as near as could be judged, at the rate of about 250 cubic feet per hour. In order to prevent leakage while the repair was being made, the broken ring was wrapped with copper wire to bring the parts together. The cover was placed over the joint and one of the longitudinal welds made, after which the cover was turned, as described above. However, in making the turn the broken ring was in some way disturbed, which caused the leak to break out as badly as it originally had been. No difficulty was experienced, however, in making the welds, owing to the fact that the welding iron caulking forced the

gas to escape out of the ¾-inch vent pipe, from the end of which it can be seen burning, the flame being about 2 feet 6 inches long.

These covers can usually be placed and welded over the expansion coupling without reducing the pressure whatever, but in this case, owing to the great amount of gas escaping and to the very bad condition of the coupling, the gas pressure was lowered to about twelve pounds.

This particular repair is described in detail in order to more clearly bring out the possibility of using the torch even under difficulties which would appear to make its use impossible.

The total length of the weld, including the two end welds, was eight feet, and on account of the weight of the cover and the amount of metal required to make the end joints, the welds were necessarily very heavy. The total time to weld the cover in place, with two operators, was three and a half hours each.

The total cost for making the welds was:

2 men, 3½ hours each	$2.10
240 cubic feet of oxygen	3.60
230 cubic feet of acetylene	4.60
12 pounds of welding iron	.96
Total	$11.26

Add to this the cost of the cover and other material, which was $20.82, made a total cost—exclusive of the necessary labor which is attached to any work of this nature—of $32.08.

The cover used in this case, which cost $20.00, was not made in the Gas Company's shop. It is believed that for future work these covers can be made in the shop for about half the price of this one. The use of the cover on the above occasion removed the necessity of shutting down a line which served two towns and a large adjacent territory, thus showing the very great advantage of making a repair in this way.

Removing an Expansion Joint.

It sometimes happens that an expansion joint leaks in a main that may be closed down without any great inconvenience

to any consumers. In such a case it would be cheaper to remove the expansion joint and weld a sleeve over the two ends of the main than to make the repair in any other way.

If the main should be a small sized main no difficulty would be experienced in doing this, but when such work is done with the welding torch on a large sized main, in which it would be possible for a large volume of an explosive mixture to form which might be set off by reason of the flame or the heat of the hot metal, it is necessary that some precautions should be taken to guard against this possibility. It was at first thought that a repair of this nature would be a very dangerous undertaking, but it has been successfully demonstrated that this work may be done with no danger whatever of any explosion occurring, providing the necessary precautions are observed. However, such a repair should not be undertaken only when a person who thoroughly understands such work is present.

Fig. 21 shows the method of making this repair. *A* is a sleeve made of 7-inch pipe for a 6-inch main, and of 9-inch pipe for an 8-inch main. The sleeve should be thoroughly caulked with asbestos in order to prevent gas from leaking while making the repair. *B* is a pipe screwed in the main a little distance from the point of repair, and which is provided to carry off the gas.

Before welding the two ends of the sleeve one of the valves is opened just sufficiently to allow enough gas to pass into the main and out of pipe *B*, and to maintain a pressure of from two to three inches water column. After the main has thus been purged of any explosive mixture it may have contained, the two edges of the sleeve may be welded with absolute safety.

Two expansion joints have been removed from a 6-inch main by our company, and replaced by a sleeve welded to the main in accordance with the foregoing method with entire satisfaction, but, unfortunately, no photograph was secured at the time.

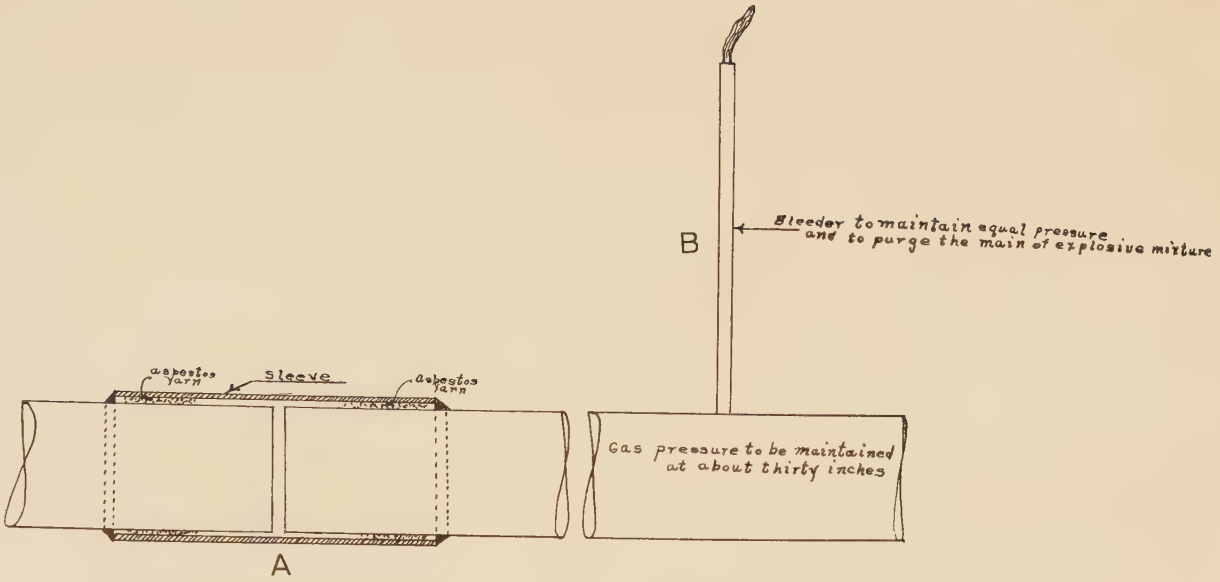

B
Bleeder to maintain equal pressure and to purge the main of explosive mixture
asbestos yarn
Sleeve
asbestos yarn
Gas pressure to be maintained at about thirty inches
A

FIG. 21.—Method of replacing an expansion joint with a welded sleeve.

Cutting Out a Portion and Inserting a Like Amount of New Main.

A repair to a gas main when it is necessary to remove a portion and replace with new, can be more satisfactorily made by oxy-acetylene welding than by any other method, and will result in a repair that will restore that portion of the main to as good a condition as it had been originally.

When using the oxy-acetylene method to make such a repair, if the main is a large one (6-inch or above) precautions should be taken against the possibility of an explosive mixture in the main, as was outlined in connection with the repair in Fig. 21, and was explained therewith.

This repair differs from the former, however, in that this one is the removal of a section of pipe and the placing therein of a new section by means of two butt welds, and in this case necessitating the use of bags in order that the section of main will be entirely free from gas. Fig. 22 shows in detail the manner of making this repair and it will be seen that the essential points of precaution are the same as shown in Fig. 21. The question might be raised why it is necessary to take such precautions when the portion of the main in which the repair is being made is entirely shut off by bags from the other portion of the main in which the explosive mixture would be present. However, with the possibility of one or the other of the bags breaking and thus allowing the explosive mixture to come in contact with the flame of the torch, it will readily be seen, that should the mixture formed in the main be in the proper proportion, the trouble caused might be rather serious.

A repair of this kind may also be made in a main in which the gas flows only in one direction. In order to make the work absolutely safe, a by-pass should be extended around the portion being repaired in order to keep a pure gas on both sides, and as formerly, maintain a pressure of about 30 tenths in the main.

In small sized mains a repair of this nature can be made without the necessity of bagging the main unless one or the

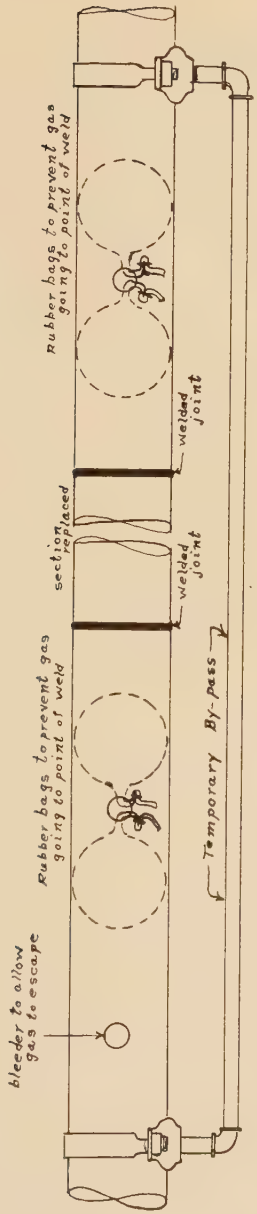

Bleeder to allow gas to escape
Rubber bags to prevent gas going to point of weld
Temporary By-pass
Welded joint
Welded joint
Section replaced
Rubber bags to prevent gas going to point of weld

FIG. 22.—Method of cutting out a portion and inserting a like amount of new pipe.

other of the valves leak, and then only on the side of the repair from which the gas flow is coming.

Repairs to Sockets.

One of the principal troubles in high pressure distribution has been the tendency for leaks to develop in the line at the sockets. These socket leaks have been repaired in the past by a leak clamp which depends on a rubber gasket to make the joint gas tight, as in the ordinary expansion joint. This method of repair is quickly made but has the disadvantage of being subject to the possibility of leaking again in the future.

With the advent of the oxy-acetylene welding torch in distribution work, a method was at once offered to make an absolutely and permanently tight joint. The difficulty encountered in making a weld around the face of a socket to prevent a leak, especially when the leak is a bad one and leaking all around the joint of a recessed socket, is that it is impossible for the operator to weld into the recess and reach the point of the leak. A bridge must be made of the weld from the pipe to the edge of the socket, thus leaving a passageway back of the weld for the passage of the gas. As the weld is made and the opening for the escape of the gas becomes smaller, the gas will escape with increasing velocity, increasing more and more as the opening becomes smaller. As the point is reached to make the weld over the final opening, the velocity has become so great that it will blow the molten metal and prevent a tight weld being made.

This difficulty can be very easily overcome and a tight joint made in the following manner: When the operator has brought the weld up to the point where the velocity of the issuing gas is too great to allow the final weld being made, the operator or helper should quickly drive the red hot metal into the opening by means of a hammer and chisel, closing it and thus preventing the escape of gas. Then with the torch weld over this point to finish the joint.

It has been suggested that this repair can be made by first caulking under the recess of the socket with copper wire in

FIG. 23.—Leaking coupling welded to the top, showing gas burning from opening.

FIG. 24.—Repairing a leaking coupling. The operator should quickly drive the red hot metal into the opening by means of a hammer and chisel.

order to prevent as much as possible the leakage while the weld is being made. The above method will, however, prove to be the most satisfactory and will also be the quickest and likewise the cheapest way to overcome this difficulty.

Figs. 23 and 24 show a 3-inch socket being repaired by welding around the socket in the manner as described above. This particular leak proved to be a rather difficult one for the operator to repair owing to the fact that the pipe when laid had not been screwed into the socket far enough, exposing three threads outside the socket. It was thus found necessary to build the weld from the thick part of the pipe to the edge of the socket in order to avoid the comparatively thin metal at the thread, thus making an unusually heavy weld. This joint was leaking very badly which is demonstrated by the burning gas shown in Fig. 23.

To make this weld it took one hour and forty minutes, using a No. 5 tip and 6 feet (10 ounces) of 3/16-inch welding iron. The tip used was too small for this joint; nothing less than a No. 6 and, preferably, a No. 7 tip, should be used for work of this nature.

The joint on the other end of the socket shown in the illustration was also welded on account of a slight leak. A No. 6 tip was used and on account of the leak being small and the larger tip used, the weld was made in forty-two minutes, using 3 feet, 6 inches (5.8 ounces) of 3/16-inch welding iron.

The cost of the first joint, including labor and material, was $1.91; of the second joint $1.08. The average time to make these joints, if the operator were doing a number of such joints and became thoroughly familiar with the work, could probably be reduced to about a half hour, this being the actual time on the welds, and not allowing for any time for periods between welds.

Changing a Connection.

Many times a saddle will leak, especially those which were put on the main in the old way, and with which those distribution men who have been connected with high pressure dis-

FIG. 25.—Welded service connection to displace old saddle connection. Note pipe has been pulled over to show strength of weld.

tribution previous to the adoption of the lead gasket, are familiar.

When a saddle is found leaking the first thought is to eliminate this trouble and make a connection which will be absolute proof against leaks. A method of making a change from a saddle to a welded connection is shown in Fig. 25. The only portion of the work necessary to make this change entirely satisfactory is to get rid of the saddle after the new connection has been made. The welded connection to the main has been illustrated and described under "Services," and is thoroughly understood.

The new welded connection having been made, the removal of the saddle is accomplished in the following manner: After the fittings have been removed from the corporation cock, an ordinary high pressure drilling machine is attached to the cock in the same manner as an ordinary tap. However, in this case, a combination drill and tap is used instead of a drill, and with this the hole in the main is tapped out for a ⅜-inch threaded steel rod, or whatever size desired. The tap is removed past the cock and the cock closed; the drilling machine is then removed. The steel rod is then attached to the cock in the same manner as the drill had been, the cock opened and the steel rod screwed into the main. The saddle is then removed leaving the steel rod screwed into the main and effectively closing the opening. The rod is then cut off at the main and welded over, which leaves the point where the opening had been, in as good a condition as any portion of the pipe.

The above method of closing the opening in the main in order that the saddle may be dispensed with should always be followed out when the drilled hole is any size larger than ¼-inch. Should the drilled hole be of the above size or less it may be welded as shown in Fig. 26, which method consists in a helper holding a pointed steel rod in the opening while the operator welds around it, after which the rod is cut off, leaving the opening completely covered by a weld.

A very important precaution to be observed when making repairs of this nature is to guard against the possibility of

FIG. 26.—Closing the old opening after saddle has been removed.

melting the lead gasket. This can be readily guarded against by the helper keeping the saddle and pipe cool by occasionally pouring water over them during the time the operator is making the welded connection.

This entire change may be made with the full pressure in the main, and forms a very interesting piece of work and one that is of the utmost importance in order to make a satisfactory job. All that is necessary to do this work, in addition to the ordinary tools, is the steel rod.

The cost of making a change of connection of this kind will average about $1.25, which includes all labor incident to the welding and all material, including acetylene, oxygen, etc., but does not take into account the labor necessary for digging or any other labor which would be necessary in connection with work of this nature.

Fig. 27 shows a repair which consists of placing and welding a sleeve over a 2-inch main, with the full pressure in the line.

In this case a new 2-inch valve had been placed, but when the weld to connect the old main with the new connection had been made and gas turned on, it was found that the joint leaked very badly. The operator, finding it impossible to make the joint gas tight owing to the bad condition of the old pipe, took a piece of 2½-inch pipe about 7 inches long, cut it with the cutting torch lengthwise on one side, spread it until it passed over the 2-inch main, and brought the edges together again over the defective weld. The edges and ends of the 2½-inch pipe were then welded, making it an absolutely tight joint.

The time to do this work, using a No. 5 tip, was one hour. Six feet (5 ounces) of ⅛-inch welding iron was used. The total cost of the repair, including all material and labor for welding was $1.50.

Fig. 28 shows a change being made to the connection of a small lateral line in which it was found necessary to make a reducer. When this is required it may be very readily made by welding a short piece of pipe of a smaller size into the larger pipe. In this way a reducer may be made of any

FIG. 27.—Welding a sleeve over a bad joint with full pressure in the main.

size desired, using in some instances where it may be desired to reduce from 3 inches to 2 inches, or from 3 inches to 1½

FIG. 28.—Making a reducer on an old gas main

inches, two or it may be three short pieces of pipe of different sizes until the desired reducer is made.

Patching a Leaking Gas Main.

Many leaks develop in gas mains caused by electrolysis. Such a leak will generally show in the body of the pipe in the nature of pits. It has been the custom to repair such leaks by placing a blank saddle over the part of the main affected. It was suggested, however, that such a leak would be repaired better and with more lasting results by welding a patch of new metal over the part of the main affected.

Fig. 29 shows a test being made to prove the practicability of repairing in this way. The work was carried out under the same conditions of pressure and leaking main as would be encountered in actual practice, and proved entirely satisfactory in every respect, proving beyond a doubt that the repair could be made by welding and restore the gas main to as good a condition as it had originally been.

In order that the test could be made under actual conditions, a piece of 4-inch pipe was connected to the high pressure main and gas turned into the pipe, the pressure at the time of the test being about 35 pounds. The apparatus used in this test was somewhat crude, but will be improved upon for permanent use along the general lines shown.

To make a repair of this nature a lever should be attached to the gas main by a removable clamp of any design. To the resistance arm of the lever is attached a loose rod, which in turn is attached to the patch to be welded on by means of slight welds, or in any other manner so that it may be brought down firmly on the point of the main to be repaired. To the underside of the patch, in order that the leak will be entirely stopped while welding, wet asbestos wick or sheet asbestos should be attached. When the patch is brought down on the leak, the lever should be wedged in place in order to hold it firmly while the weld is being made.

The time to make this repair, as shown, was one hour and twenty minutes, using a No. 7 tip. The material used was 44 cubic feet of acetylene and 51 cubic feet of oxygen, and about 6½ ounces of filling metal. The complete cost, including labor,

FIG. 29.—Method of welding a patch on a leaking gas main.

being $2.33. The patch used in this work was 3/8-inch boiler plate, which is entirely too heavy. In practice 3/16-inch boiler plate would be used, which would probably reduce the cost for making the repair to about one-half of that shown above.

The foregoing illustrations of making repairs with the welding torch will serve as examples of the wide field to which oxy-acetylene welding may be put in distribution work.

In this connection the writer wishes to say at this time that some of the most useful practices in this line of work have been suggested by the foreman, or it may have been by one of the men working under the foreman. It has always been the practice of our company to carefully consider any suggestions which come from these men, and it may be truthfully added that some of the suggestions coming from this source have proven to work out to the greatest advantage to the company.

In closing it may be said that oxy-acetylene welding in distribution work is only in its infancy and that it will not be long before it will be accepted universally throughout the gas fraternity, as a necessity for the accomplishment of the best work in the best way.

The writer wishes to express his appreciation for the assistance and co-operation given him in the preparation of this paper by Mr. George W. Savage, Superintendent of Distribution.

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Mr. J. B. Redd (Jersey City, N. J.): (Written discussion communicated.) It is a pleasure to discuss a paper written upon an interesting subject and especially pleasing when you know that the work described was performed equally as well as the subject is dealt with in this paper. I make this comparison as I had the opportunity, in company with the author, of viewing the welding upon an 8-inch pipe line recently constructed by the Philadelphia Suburban Gas Company.

This paper has covered the process of laying a welded pipe line, and as other speakers will discuss the work in general I will confine my remarks to the welded joint only.

I have made a careful study of Figs. 4, 5 and 6, described upon page 1079, and the work described in Fig. 6, from all appearances, is a first-class weld. We could not, however, call this an ideal weld unless a careful analysis was made of the heart of the weld to determine what change, if any, has taken place in or caused by the filler metal used in making the weld or the pipe metal adjacent to the weld metal.

The filler metal used should be of the very best quality to insure an ideal weld, and much care should be exercised in selecting this material. Ten ounces of filler material is sufficient to weld an 8-inch joint if care is taken to obtain an even distribution of metal over the entire joint. The tendency among inexperienced operators is to build up the joint from ⅛ to ¼ of an inch above the pipe, which means a waste of both time and material.

The time necessary to complete an 8-inch weld varies with the operator. This usually being from 20 to 30 minutes which includes the time necessary for tacking the joint in four places. If more time is consumed it means an increased cost and a greater possibility of the work not being performed in a first-class manner and that an excess of metal was used or the welding allowed to cool, which, of course, necessitated re-heating the added metal. This is not going to help the weld but is very likely to cause the new metal to be burned or to become oxidized.

The figures given by a number of engineers for pipe welding vary considerably. This is due to the experience of the operator or the manner in which the long lengths of pipe are handled, or the time lost by the welder in moving from joint to joint.

Many different kinds of tests have been made as to the strength of the weld but the tensile strength and the resistance to loading strain tests seem to be the most satisfying to the majority of engineers. It has been proven by these tests upon an 8-inch welded pipe that the welded joint will stand a strain of approximately 17 tons per square inch while the tensile strength of the weld when properly made is practically the same as the pipe itself.

An interesting test dated March 22, 1916, was made by Dr. Hal Trueman Beans, of Columbia University, for the New York Steam Company, in part as follows:

Objects Of Tests.—To determine the nature of the change (if any) in the iron used in making welds with oxy-acetylene under the conditions used by the Davis-Bournonville

Co., in welding wrought steel pipe for the New York Steam Company.

I made chemical analyses of the sample of welding rods and of a composite sample of portions of some fifteen small welds. These analyses show in general that practically no chemical change has occurred during the welding process.

Microscopic Examination.—This examination was made more particularly to determine what changes, if any, had occurred in the original pipe metal and in the weld metal during the process of welding. For this examination a longitudinal section was cut from the original sample of welded pipe submitted by the New York Steam Company.

Fig. 8 (herewith attached) Section taken at point designated by 8 on sketch. Here the weld metal is at the extreme right and the pipe at the left as in Fig. 7. The slag in the pipe at the left has suffered incipient fusion as in Fig. 3 and Fig. 4, and, in the zone of higher temperature along the central line of the photomicrographs, there has been complete fusion of this material. The iron matrix seems perfectly joined and shows a continuous and uniform change from pipe metal to weld metal.

Since this report the New York Steam Company has adapted the welded joint to their steam line work with splendid results. The engineers of the company are big boosters for the welded joint and are always ready to recommend the system.

The welded joint for pipe line work has passed the experimental stage. It has been thoroughly tried out and found to be the ideal method of jointing steel or wrought iron pipe and the gas engineers who were the first to adopt this method are to-day its biggest boosters. I believe those engineers who have not made use of the process owe it, in justice to themselves and their companies, to try out this type of joint at the first opportunity. A good many of us will not try something new until it is forced upon us. This was the case with a certain gas company upon application for franchise in an adjoining town. Several rich and prominent citizens upon gaining the information that gas would be brought into the town raised

the objection that there was a possibility that the gas leaking from the main would destroy their beautiful flowers, trees and shrubbery. The manager for the company had been considering welding the pipe line and met the objections of the influential citizens by stating that his company would weld the entire line and all service connections. In other words, would construct a "bottle tight" line and prevent all leakage. After a demonstration the objections were withdrawn and the franchise granted.

Pipe welding has received some set backs due to the fact that inexperienced operators attempted the work with inferior equipment. There are a large number of concerns who have attempted to manufacture oxy-acetylene welding and cutting apparatus without a thorough knowledge of the business and depending entirely upon second-hand information. These concerns cover a limited territory endeavoring to secure orders on price alone. They train their guns upon the purchasing agents and sometimes find one who considers that when he has saved his company a few dollars on the initial cost of the equipment he has done something important. He does not, however, consider the difference in the cost of operating the torch and the heavy loss from poor quality of work which results in the equipment being finally relegated to the scrap heap.

I have known of cases where engineers have purchased oxy-acetylene welding apparatus in about the same manner as a large number of our good housewives purchase ranges and other gas consuming appliances. We criticise the purchasers for buying such appliances and on the other hand the gas man who made such criticisms will go into the market in the same blind manner and purchase oxy-acetylene apparatus. They do not consider that they are purchasing a gas appliance, apparatus which must be constructed with the greatest of care as the gases to be used have to be reduced from 1,800 pounds pressure down to a few pounds. This fact alone should convince the purchaser that for the safety of his men and to obtain the best results he should not allow the price factor to enter into the deal. A temperature sufficiently high to melt cast

iron or steel can be obtained with any type of torch using a mixture of oxygen and acetylene gases; therefore, the essential features to be considered in the purchase of welding apparatus are: The manner of mixing these gases for economy in operation and to produce a non-oxidizing flame, the lightness and durability of the torch and the general up-keep of the apparatus.

Much credit is due to the gas engineers who have developed this method for jointing steel and wrought iron pipe, and like all good pioneers any of them are ready and willing to recommend the method to their brother engineers of the gas fraternity. In fact, many of them have assumed the same attitude toward pipe welding as the commercial agents and industrial fuel engineers have assumed in co-operating with the manufacturer of industrial fuel appliances in developing the industry field, which to-day is the largest revenue producing field open to the gas company in both large or small communities.

The Chairman: The following written discussion was received from Mr. A. M. Boyd.

Mr. A. M. Boyd (Philadelphia): (Written discussion communicated.) The paper which has just been read is, I believe, an up-to-date treatise on the subject of oxy-acetylene welding and its suggestions should prove of great value to companies now using welding outfits as well as those contemplating their use.

There are a few questions relative to the paper which I would like to have answered by the author:

On page 1088, subject flanges, the statement is made that it is much cheaper to make flanges from steel plate than to buy the ordinary extra heavy forged steel type. On page 1089, same subject, particular stress is laid on the necessity of having the weld, when an extra heavy forged steel flange is used, sufficiently large to cover all the threads in order to maintain the maximum strength of the pipe. I would like to know if the extra cost of using the ordinary commercial steel flange over the home-made flange is due to the heavy weld necessitated on

account of the flange being threaded, and the pipe being screwed only part way into it. If this is so, it occurs to me that it should be possible to obtain an unthreaded flange drilled to admit plain end pipe, which would obviate the necessity of the heavy weld and at the same time provide a fitting designed especially for the work for which it was intended at less cost than the home-made type.

I would like to know just how a renewal of a service such as shown on page 1101 would be handled, assuming it had rusted out at the main through corrosive action of the soil or been affected by electrolysis. The service connected as shown is undoubtedly a much more economical proposition than if a corporation cock is used at the main, but I am inclined to think that when renewals were found necessary the work would be attended with some difficulties.

I would also like to know if any attempt has been made to weld a service connection of the type shown on page 1101 to a cast iron main and if such practice is considered advisable and economical.

In many situations it is necessary to have a number of service barrows, depending upon the size of the territory covered and the distance that can be economically traveled by a service barrow. With four or five such service gangs, would the author recommend that each cart be equipped with a welding outfit, or should some rapid form of transportation be provided to move an outfit from one gang to another as required to make a weld?

I assume that from the curb cock into the house any necessary joints in the service are threaded and that it is not considered necessary to have these joints welded. If, however, the curb cocks could be eliminated would the author, for the sake of uniformity, consider the welding of the entire service advisable, and under such conditions what would be the probable increase in cost, if any?

On page 1113 is an illustration of a repair made on a main with a sleeve, after removing a leaking expansion joint. In the descriptive matter this sleeve is referred to as a piece of

pipe one size internal diameter larger than the pipe to be repaired, but no mention is made of the sleeve being split. It is not clear to me just how the pipe sleeve is slipped on.

I understand considerable difficulty has been experienced in welding larger sized mains in fairly cold weather. I would like to know if any difficulties have been found in Chester, and if different methods are followed when the temperature of the air and pipe is in the neighborhood of 35° to 40° F.?

Mr. Walton Forstall: (Written discussion communicated.) This paper, representing results of much experience, undoubtedly will prove of great value to all those distributing high pressure gas. So far, I personally have not had this privilege, and, therefore, my remarks necessarily must be brief.

On page 1083, the table of costs for an 8-inch turning joint would be made still more valuable if it included the quantities on which the items were based. For instance, under "Labor" so many hours for the operator (helper) with the rate per hour; also for each class of material, the number of units used, and the cost per unit. The same comment, of course, applies to all similar tables given in the paper.

On page 1084 are costs for the ditch joint and for the stationary joint. It is not clear to me whether the cost in each case is the actual time for the joint, and, therefore, should compare with the $1.10 for the turning joint, or includes some, or all, of the charges given for the turning joint on page 1083, and, therefore, should compare with the turning joint cost of $1.28 or $1.47.

Mr. J. B. Hirst (Chicago): (Written discussion communicated.) Mr. Wilde in his very excellent and comprehensive paper on pipe welding in gas distribution work has treated the subject so thoroughly that there is little room for discussion and almost no room for criticism.

During the summer of 1914, the Peoples Gas Light & Coke Company laid about 10 miles of welded steel pipe in sizes, 16, 12, 8, 6, and 4 inches, about 75 per cent. of the pipe laid being 12 inches. The detailed descriptions and costs in Mr. Wilde's

paper are, I believe confined almost exclusively to sizes 8 inches and smaller. The comparatively large size of the pipe laid in Chicago and the fact that the greater portion of it was laid through densely populated districts where traffic is congested, developed problems which I think differ slightly from those encountered by Mr. Wilde in his work.

These differences in conditions coupled with the fact that we started our work with no actual experience in pipe welding, led to the development of slightly different methods in Chicago from those used in Philadelphia.

When I say that we had no actual experience, I do not mean you to understand that we started our construction work with no knowledge of the subject. We had a very large store of excellent advice, most of which was given to the writer by Mr. Wilde himself.

Joints.

For main sizes up to and including 8 inches, the welding tips used by us correspond to those recommended by Mr. Wilde on page 1072. For 12 and 16-inch mains we used size No. 10. After the men had become thoroughly familiar with the handling of the torch and were able to make a good weld, we found by experimenting with the smaller tips that the speed of the work depended on the size of the tip used. In the larger main sizes the men could work equally well with a No. 8 or a No. 10, but could do about twice as much work with a No. 10. The tip set the pace and the welder was forced to keep up.

Kind Of Joints.

Mr. Wilde describes three kinds of joints, *viz.*, ditch, stationary and turning joints. In our work we found that we could limit the number of kinds of joints to two, *viz.*, ditch and turning joints. In order to do this we had to develop what we called a pipe dolly. This dolly was made of two parallel rollers mounted on a piece of 3-inch blocking. When these dollies were placed under the pipe with rollers up, and with the axes of the rollers at right angles to the axes of the

Cost Data. General Averages.

Size	Kind	No. joints	Cost labor	Cost acetylene	Cost oxygen	Cost filling iron	Total cost
4″	Turning	427	$0.14	$0.21	$0.15	$0.03	$0.53
4″	Ditch	144	0.27	0.27	0.21	0.04	0.79
6″	Turning	176	0.20	0.32	0.26	0.06	0.84
6″	Ditch	95	0.39	0.44	0.34	0.08	1.25
8″	Turning	52	0.18	0.47	0.36	0.12	1.13
8″	Ditch	58	0.62	0.56	0.52	0.15	1.85
12″	Turning	717	0.67	0.97	0.68	0.16	2.48
12″	Ditch	231	0.98	1.47	1.02	0.21	3.68
16″	Turning	49	0.82	1.13	0.61	0.21	2.77
16″	Ditch	8	2.27	2.90	2.58	0.34	8.09
		Total Average—Turning and Ditch Welds.					
4″		571	0.17	0.23	0.18	0.03	0.61
6″		271	0.27	0.36	0.29	0.07	0.99
8″		110	0.41	0.52	0.44	0.14	1.51
12″		948	0.75	1.09	0.77	0.17	2.78
16″		57	1.02	1.38	0.88	0.22	3.50

pipe they served as a means of shifting the pipe endways along the ditch. When they were placed under the pipe rollers up, with the axes of the rollers parallel to the axis of the pipe, they served as a means of turning the pipe in place, without changing its position relative to the ditch. By placing two 100 to 150-foot sections of 12 or 16-inch welded pipe on these dollies we found that they could be turned very easily with tongs while a welder completed the final joints.

We also found that these dollies could be used in the bottom of the ditch to great advantage. When it was impossible to weld up a full block of pipe and lower it into the ditch, the block was welded up in sections, placed in the ditch on the dollies, ends brought together and tacked. The pipe was then raised slightly so that the dollies could be shifted to act as rollers for turning the pipe. The whole section could then be turned in the ditch as the junction welds were being made.

The additional equipment necessary for this work was inexpensive and was more than paid for by the difference in cost between the stationary and turning joints.

The relations between the cost of turning welds and ditch welds as shown in the table does not seem to correspond with figures given by Mr. Wilde on pages 1083 and 1084.

He shows an 8-inch ditch weld to cost about 2.56 times as much as an 8-inch turning weld. The table shows that in our operation the 4-inch ditch weld costs 1.49 times as much as a 4-inch turning weld, the 6-inch ditch weld costs 1.49 times a 6-inch turning weld, the 8-inch ditch weld costs 1.63 times an 8-inch turning weld and a 12-inch ditch weld 1.48 times a 12-inch turning weld.

I think perhaps a little more detailed description of Mr. Wilde's method of making a ditch weld would clear up this discrepancy.

Mr. Wilde's statement that the number of ditch welds should average about 14 per mile, or from 5 to 10 per cent. of the joints, depending on whether 20 or 40-foot lengths are used, is evidently based on conditions found in outlying residence

districts, where traffic is very light. In our work through very congested districts, we found that the number of ditch welds necessary was well over 20 per cent. of the joints made.

In Table I, Cost to Weld Joints, page 1085, I notice that the volume of acetylene consumed per joint, is as a rule less than the volume of oxygen consumed. In our work we found this condition reversed in every size and practically every joint. We found that our volume of acetylene was greater than the volume of oxygen used.

20 Versus 40-Foot Lengths.

Our engineers were among those referred to in Mr. Wilde's first paragraph under the above caption.

After about half of our pipe was laid, however, we decided to try 40-foot lengths and were very much gratified to find that the long length occasioned very little inconvenience or additional cost to handle.

Connections.

The method of making connections to existing mains when valve leaks, described here seems to be very simple and perfectly safe.

As yet we have made no such connections to our existing system, but if occasion arises we shall certainly try this method.

Flanges.

The method of making flanges described here is very interesting. Most of our flanges were larger than 4 inches and all were of either forged or cast steel. The cast steel flanges were welded to short pieces of pipe with a torch, while the forged steel flanges were welded to short pieces of pipe by a special welding process in the factory of one of our large local pipe manufacturers.

Our drip connections and lateral connections were very similar to those described by Mr. Wilde. We have, however, made no lateral connections with gas on.

Pipe Bending.

Because of the congested sub-surface conditions found in our streets it was necessary to use very short radius bends, most of them being from 5 to 10-foot radius. Four inch pipe was bent cold, on the job, while bends in larger sizes were made by a local pipe manufacturer.

Services.

I noticed Mr. Wilde uses straight service connections, no allowance being made for a movement of either main or service at the connection.

Our service connections were similar to his, except that we used a return bend, or service loop, at the connection to provide for travel of the main or movement of the service, due to settling or expansion and contraction.

Repair Work.

I am very much interested in Mr. Wilde's description of methods used in covering expansion joints, repairing leaks and making connections with pressure of gas on the main.

The methods described are very simple and ingenious and if the occasion arises I am sure we will profit by Mr. Wilde's experience and follow his method in making repairs.

The Chairman: I see Mr. Jones in the audience, and as he is the father of this business, we want to hear from him.

Mr. E. C. Jones: I very much appreciate Mr. von Maur's complimentary introduction but he has confused me with my son, L. B. Jones, who did the initial work on the oxy-acetylene welding of street mains, and prepared the first descriptive paper on the subject, and it is he and not I who deserves the credit for it.

I would like to speak for a minute on another phase of oxy-acetylene welding not mentioned in this very instructive paper that has been presented to us. We have become so used to the oxy-acetylene welding of mains and the use of the cutting torch that I fear many of us are getting careless. In the use of welding material with the oxy-acetylene torch, we strive

to make a homogeneous welded joint, which if carefully and properly made, is as strong or stronger than the pipe itself.

In puddling pig iron in the process of manufacturing steel, you all know that air is forced through the molten metal for the purpose of removing carbon, and that the carbon content of pig iron is about 5 per cent., while steel has about 1 per cent. of carbon and the limit or line of demarcation between cast iron and steel is about 2 per cent. Now, has it ever occurred to you that this process may be reversed in the making of welded joints, and it is being done by careless welders by using an excess of acetylene at the torch, thereby puddling carbon into the welding material and converting it into cast iron? It has been my misfortune to see some of these cast iron joints, and I cannot imagine a more embarrassing situation for a distribution man than to see one of his pet joints of the stove pipe variety drop apart. Let me say to you be careful about making joints which cannot be repaired while the main is under pressure.

A word along the lines of Safety First. We are in the habit of purchasing oxygen confined in steel cylinders and placing them in the hands of our workmen for use, acting entirely upon faith that the cylinders contain oxygen, and heretofore this has only been proven by lighting the torch. To ask a workman to apply a match to a torch attached to a tank of gas supposed to be oxygen, without having positive knowledge of the contents of the tank is more of a responsibility than I would like to assume.

In San Francisco there was a concern manufacturing electrolytic oxygen and hydrogen by the well-known method of decomposing water by the help of electricity. This concern was selling oxygen in tanks in oxy-acetylene welding and in July last shipments of this oxygen were made to different points in California. When the oxygen tanks in this shipment were connected up to the torch and lighted violent explosions took place, killing several people, and injuring many others and with much damage to property. Upon investigation it was discovered that in making repairs to the battery cells in

which this oxygen was generated, a workman in reconnecting the cells had crossed the wires, thereby reversing the poles so that the oxygen tanks were filled with an explosive mixture of hydrogen and oxygen. Three serious accidents took place within as many days, but none of them happened in connection with any gas company's work.

The Pacific Gas and Electric Company has a Central Safety Committee, which has general oversight of the application of Safety First principles in the gas and electric business. There are also sub-committees in all the plants of the company, both gas and electric. As Chairman of the Central Safety Committee, I realized the danger of a re-currence of accidents to tanks supposed to contain pure oxygen, and I immediately issued orders that all oxygen tanks used by our company must be sent to the company's laboratory and their contents tested before being placed in the hands of the workman to be used.

The method employed in testing oxygen is to remove 10 cubic centimeters of the contents of the oxygen tank in a gas sample tube. This tube is taken to the laboratory and the gas is passed into a Hempel explosion pipette and on the passage of a spark, if the gas does not explode, it is assumed to be safe to use; but as a further precaution the gas is passed into a pipette containing a solution of pyrogallate of potash. This reagent absorbs the oxygen down to its residue and it is interesting to sometimes test the residue which amounts to about one-half of 1 per cent. to determine if it is hydrogen or nitrogen. This enables us to keep a check on the origin of the oxygen whether atmospheric or electrolytic. After a tank of oxygen has been tested it is labeled with the date tested, character of the contents, and chemist's signature. The tank is then sent into the field for use. After the oxygen has been entirely used from the tank and before the tank is returned for refilling, the label is destroyed by scraping it from the tank. It is not my purpose to criticise or condemn any methods employed in the manufacture of oxygen, but I feel it my duty in view of the recent accidents in California to sound a warning

against the use of oxygen without first carefully testing it to determine if it is explosive.

THE CHAIRMAN: I trust we all appreciate the significance of Mr. Jones' remarks.

Mr. Wilde, will you close the discussion please?

MR. CHARLES WILDE (Chester, Pa.): Referring to Mr. Jones' remarks, I would say that what he says in reference to the possibility of an explosion by reason of an explosive mixture, by chance, being charged into the oxygen tanks, is a lesson to all of us and one which has already taught me to be careful because we do not and had not thought it necessary to have such tanks tested. We have never had any trouble but I believe it is best to be on the safe side and test all such tanks.

If there are no other gentlemen who desire to make further remarks, I would like to pick out two or three points in my paper and bring out a point or two that may not be clear.

Under joints I say that the strength of the weld, so far as it's being a gas tight joint, will depend upon not over-heating the metal, which condition can be determined by the boiling or globules in the molten metal; these globules, in the metal, will as it cools down leave a porous condition of metal resulting in a leaking joint. When the welders are taught to avoid this condition, very seldom will a joint be found that leaks. At first we had quite a lot of trouble on account of the porous metal but now that our men thoroughly understand this condition of temperature very seldom do we find a joint that leaks.

A little further on will be found a reference to tips. We think it is important to look and see that the welder always uses the proper size tip.

I would like to call attention to the method described for making a lateral connection. In this I do not bring out as I would like, the importance of having the filling metal and the metal of the pipe thoroughly mixed and not just put one on the other. For instance—if the metal of the pipe is not brought to the proper temperature the filling metal will just be plastered on, as the saying is, and there will be no strength

to it. It would not matter if you made the weld an inch thick, there would be no strength under these conditions. But if you get the metal of the pipe, no matter how thin a surface, brought to the proper temperature, that is, to the molten state, and also get the filling metal running to the metal of the pipe at the point of welding, a joint will result, if cut through in section, that would be impossible to detect where the metal put on for filling started with the metal of the pipe. It would be a perfectly homogeneous joint and there would be no signs of any seam in it whatever.

I received a letter from Mr. Walton Forstall, in reference to table found on page 1083, and to the ditch joint found on page 1084. I would say in answering the first question that the various items entering into this table were as follows: Labor about 28 minutes the welder receiving 27½ cents and the helper 20 cents. Acetylene about 19 cubic feet, at a cost in the shop of 2 cents per cubic foot. Oxygen about 24 cubic feet, at a cost in the shop of about 1¾ cents and welding iron about 10½ ounces cost 11 cents per pound. Answering Mr. Forstall's second question, I would say that the table for the ditch joint is in comparison to the turning joint at $1.10.

The Chairman: Mr. Wilde, your paper is a valuable addition to the literature on this subject, and you are entitled to the thanks of the Institute. The time for adjournment has arrived and we must now give way to the Chemical Section.

Mr. Ramsdell: I wish to make an announcement to the members. We have gone to some trouble to have brought here the film of moving pictures "Be Careful Frst," that is owned by the Institute, and which will be run off in this room to-morrow morning at 10 o'clock. And we are particularly anxious to have as many of the members of the Institute as possible see this film, for we think it is an exceedingly important matter than can be brought before their workmen, with illustrations covering accidents that are peculiar to gas companies. This has been rented out to a good many gas companies throughout the country—as far west as the Pacific Coast, but not nearly as many have seen it as we feel should.

The closing session of the Institute will be held in this room immediately after the moving pictures have been shown, which will probably be 11 o'clock.

If there are any matters at that time that the sections wish to bring before the Board of Directors as recommendations they will be taken up and the reports of those sections will be made at that time.

THE CHAIRMAN: A motion to adjourn this section, will be in order.

The meeting is adjourned. The meeting will be immediately convened by Mr. Harper for the Chemical Section.

FINAL SESSION.

Friday, October 20, 10:45 A. M.

Mr. Wm. E. McKay, *President,* presiding.
Mr. Geo. G. Ramsdell, *Secretary.*

The President: The meeting will please come to order.

The first order of business is the presentation of "Be Careful First" film, which is the property of the Institute. In order that you may know more about this film, I will ask Mr. Jones to describe it in a little more detail.

Mr. E. C. Jones (San Francisco): Mr. President and gentlemen, it is a matter of regret that Mr. J. B. Douglas, the Chairman of our Analysis of Accidents Committee, is not able to be present to explain the film for which he is responsible. Much good has come from this film. It has been exhibited in different cities of the country, from San Francisco to the East, and it has excited much interest. It deals with the accidents common to gas works, but there are a few portraits of your past Presidents included in the film. These you may consider as "Accidents" also, and I invoke your charity while they are being shown.

(The Institute here witnessed the "Be Careful First" films.)

The President: We will now consider the report of the Committee on "National Gas Safety Code," which will be presented by Mr. W. R. Addicks, Chairman:

Mr. Addicks: I do not think it will be necessary to present this at any length, as every member has a copy.

REPORT OF COMMITTEE ON NATIONAL GAS SAFETY CODE.

October 7, 1916.

HON. GEORGE B. CORTELYOU, *Chairman,*
Public Relations Committee,
American Gas Institute,
29 West 39th Street,
New York City.

DEAR SIR:

The Committee on National Gas Safety Code respectfully submits the following report:

ORGANIZATION.

The Sub-Committee on National Gas Safety Code, consisting of Messrs. W. J. Serrill and J. B. Klumpp, made a report on December 18, 1915, to Mr. W. R. Addicks, Chairman of the Committee on Installation, Regulation and Safety Code.

A careful consideration of the recommendation of Messrs. Serrill and Klumpp that a very large committee should be formed convinced us of the necessity of having at all times a workable committee. The plan was finally adopted of having three groups composed of four committees each, to consider the proposed National Gas Safety Code, one group for the Eastern section of the United States, one group for the Central section of the United States and one group for the Western section of the United States as follows:

EASTERN SECTION:

Committee on General and Production of Gas.
Chairmanship accepted by W. H. Gartley.

Committee on Distribution of Gas.
Chairmanship accepted by Walton Forstall.

Committee on Design and Construction of Gas Consuming Appliances.
Chairmanship accepted by Oscar H. Fogg.

Committee on Gas Fitting and Appliance Installation.
Chairmanship accepted by W. A. Wood.

CENTRAL SECTION:

Committee on General and Production of Gas.
Chairmanship accepted by E. G. Cowdery.

Committee on Distribution of Gas.
Chairmanship accepted by J. D. von Maur.

Committee on Design and Construction of Gas Consuming Appliances.
Chairmanship accepted by G. R. Chamberlain.

Committee on Gas Fitting and Appliance Installation.
Chairmanship accepted by Paul Doty.

WESTERN SECTION:

Committee on General and Production of Gas.
Chairmanship accepted by E. C. Jones.

Committee on Distribution of Gas.
Chairmanship accepted by A. B. Macbeth.

Committee on Design and Construction of Gas Consuming Appliances.
Chairmanship accepted by C. N. Stannard.

Committee on Gas Fitting and Appliance Installation.
Chairmanship accepted by H. M. Papst.

This arrangement assured that every section of the United States would be enabled to consider the special local conditions affecting the proposed Code.

Selection of the members of the several groups was made and on February 17, 1916, letters were sent to each member notifying him of his appointment. On February 24, 1916, the Chairmen of the several Committees were notified of their appointment and a complete list of all the Committees with the Chairman was sent to each.

Upon receipt of the acceptances by the individual members the complete personnel of the Committee was published in the April issue of the Gas Institute *News* and a copy is attached hereto.

Each of the Chairmen of the several Committees has since appointed a secretary for his Committee.

In addition to the Committees the Institute is represented

by Messrs. W. J. Serrill and J. B. Klumpp as members of the Board of Advisory Engineers to the Bureau of Standards, which is composed of the following representatives of the associations named:

American Gas Institute—W. J. Serrill and J. B. Klumpp.
National Commercial Gas Association—O. H. Fogg and W. W. Barnes.
Natural Gas Association—S. S. Wyer.
National Fire Protection Association—C. A. Hexamer and F. J. T. Stewart.
American Institute of Architects—D. E. Waid and Julius Franke.
National Safety Council—H. W. Forster and J. M. Morehead.
Public Health Service—Dr. J. W. Schereschewsky.
National Association of Master Plumbers—T. P. McLoughlin.
Bureau of Mines—No representative yet named.

PROCEDURE.

On December 3 and 4, 1915, the first formal conference with the Board of Advisory Engineers was held at the Bureau of Standards, Washington, D. C.

At this conference a preliminary Plan and Scope of the proposed National Gas Safety Code prepared by the Bureau of Standards was presented.

The discussion of this Plan and Scope developed the desirability of preparing at once that portion of the Code pertaining to the installation of fixtures and appliances.

From further discussion it appeared preferable that the work of preparing the rules be done by the Bureau of Standards and that the tentative rules then be submitted to the Board of Advisory Engineers.

As a result of this the Bureau of Standards prepared and submitted to the Board of Advisory Engineers, Part Four (Gas Fitting and Appliance Installation) and a second conference was held at the Bureau of Standards February 23 and 24, 1916.

The two days assigned for this conference, however, were not sufficient to cover the entire matter prepared by the Bureau and only three sections (40-41 and 42) were considered.

It was found necessary to rewrite parts of the sections which were discussed. This was done by the Bureau of Stand-

ards and a third conference with the Board of Advisory Engineers was held at the Bureau of Standards April 5 and 6, 1916.

Part Four was considered in detail, section by section, and the major portion of it tentatively agreed to by all those attending the conference.

May 12 the Bureau of Standards submitted copies of Part Four for distribution to the members of the Committee on National Gas Safety Code, who were appointed to consider that part of the Code.

May 18 sufficient copies of this part were sent Messrs. W. A. Wood, Paul Doty and H. M. Papst, Chairmen of the Committees of Gas Fitting and Appliance Installation for the Eastern, Central and Western sections respectively, for each member of his Committee. These were in turn distributed by the Chairmen to the members for their criticism and suggestions. Replies from practically all the members have been received by the several Chairmen and Mr. Wood's Committee has made its report.

The Preliminary Plan and Scope divided the proposed Code into five parts, namely:

Part 1—General and Production of Gas,

Part 2—Distribution of Gas,

Part 3—Design and Construction of Gas Consuming Appliances,

Part 4—Gas Fitting and Appliance Installation,

Part 5—Information for Users of Gas,

but further consideration convinced the Bureau of Standards that additional divisions were advisable.

On April 11 the Bureau presented a revised Plan and Scope, in which the Code is to be made up of ten parts.

April 28, 1916, copies of this revised Plan and Scope were sent to all Chairmen for distribution to the members of their Committees and the work among the various Committees has been assigned according to this revised Plan and Scope as follows:

PART 1. MANUFACTURE.
Assigned to Committee on General and Production of Gas.

PART 2. DISTRIBUTION.
Assigned to Committee on Distribution of Gas.

PART 3. APPLIANCE DESIGN.
Assigned to Committee on Design and Construction of Gas Consuming Appliances.

PART 4. GAS FITTING.
Assigned to Committee on Gas Fitting and Appliance Installation.

PART 5. APPLIANCE INSTALLATION.
Assigned to Committee on Gas Fitting and Appliance Installation.

PART 6. NATURAL GAS WELLS AND FIELD STATIONS.
Assigned to Committee on Distribution of Gas.

PART 7. ACETYLENE.
Assigned to Committee on General and Production of Gas, also Committee on Distribution of Gas.

PART 8. BOTTLED GAS SYSTEM.
Assigned to Committee on General and Production of Gas.

PART 9. BLAST FURNACE, PRODUCER AND GASOLINE GAS.
Assigned to Committee on General and Production of Gas, also Committee on Distribution of Gas.

PART 10. UTILIZATION—INFORMATION FOR USERS.
Assigned to Committee on General and Production of Gas, Committee on Distribution of Gas, Committee on Design and Construction of Gas Consuming Appliances, and Committee on Gas Fitting and Appliance Installation.

All Committees are proceeding with the work in hand and progress reports have been received monthly from the Chairmen of all the group Committees and reported to the Board of Directors of the Institute.

PRESENT STATUS OF WORK.

After the preparation and submission of Part Four, the Bureau of Standards, on account of other departmental work.

was compelled to discontinue temporarily further work on the preparation of the Code, but they expect to again take up this work actively in January, 1917.

A meeting of the entire Committee has been called to be held at the Congress Hotel, Chicago, Ill., on Wednesday evening, October 18, 1916, at 8 o'clock. This meeting of the Committee will be addressed by Mr. R. S. McBride, of the Bureau of Standards, who will discuss the Plan and Scope of the Bureau's work.

Respectively submitted for the Committee,

H. B. McLean, *Secretary.*

Approved:

W. R. Addicks, *Chairman.*

Personnel of American Gas Institute Committee on National Gas Safety Code.

W. R. Addicks, Chairman.
H. B. McLean, Secretary.

GENERAL AND PRODUCTION OF GAS.

Eastern.

Wm. H. Gartley, Philadelphia, Pa., Chairman.

G. Beadenkopf, Baltimore, Md.
R. W. Bush, Brooklyn, N. Y.
F. N. Dow, Portland, Me.
C. H. Graf, Albany, N. Y.
T. F. Holden, Washington, D. C.
A. C. Humphreys, New York, N. Y.
W. P. Knowles, Richmond, Va.
W. C. Morris, New York, N. Y.
C. H. Nettleton, Derby, Conn.
H. Russell, Rochester, N. Y.
R. E. Slade, Providence, R. I.
H. von Vittinghoff, Boston, Mass.
H. D. Whitcomb, Newark, N. J.
A. D. Whittaker, Atlanta, Ga.
G. E. Woods, New York, N. Y.

Central.

E. G. Cowdery, Chicago, Ill., Chairman.

R. B. Brown, Milwaukee, Wis.
V. F. Dewey, Detroit, Mich.
G. B. Evans, St. Louis, Mo.
H. M. Harriman, New Orleans, La.
S. E. Linton, Jr., Nashville, Tenn.
Geo. McLean, Dubuque, Iowa.
F. C. Shepard, Minneapolis, Minn.
R. H. Smith, Jackson, Miss.
W. H. Taylor, Omaha, Neb.
W. H. Wright, Indianapolis, Ind.

Western.

E. C. Jones, San Francisco, Cal., Chairman.

A. B. Day, Los Angeles, Cal.
E. L. Hall, Portland, Ore.
F. K. Lane, Seattle, Wash.
A. F. Traver, Denver, Colo.
W. B. Tuttle, San Antonio, Tex.

DISTRIBUTION OF GAS.

Eastern.

Walton Forstall, Philadelphia, Pa., Chairman.

W. G. Africa, Manchester, N. H.
G. E. Allyn, Providence, R. I.
G. R. Althen, Baltimore, Md.
T. R. Beal, Poughkeepsie, N. Y.
J. A. Clark, Jr., Newark, N. J.
R. C. Congdon, Atlanta, Ga.
Harry Ellis, Camden, N. J.
A. F. Ganz, Hoboken, N. J.
J. A. Gould, Boston, Mass.
J. S. McIlhenny, Washington, D. C.
R. J. Marks, Norfolk, Va.
A. S. Miller, New York, N. Y.
C. C. Simpson, New York, N. Y.
J. T. White, Brooklyn, N. Y.
C. F. Zeek, Pensacola, Fla.

Central.

J. D. von Maur, St. Louis, Mo., Chairman.

C. W. Bradley, Chicago, Ill.
C. N. Chubb, South Bend, Ind.
F. L. Cross, Madison, Wis.
S. E. DeFrese, Chattanooga, Tenn.
J. Hellen, Grand Rapids, Mich.
J. B. Hirst, Chicago, Ill.
R. A. Jayne, Detroit, Mich.
F. W. Sargent, Indianapolis, Ind.

Western.

A. B. Macbeth, Los Angeles, Cal., Chairman.

F. R. Bain, Los Angeles, Cal.
D. E. Keppelmann, San Francisco, Cal.
C. W. Koiner, Pasadena, Cal.
W. A. Leuenberger, Tacoma, Wash.
H. C. Morris, Dallas, Tex.

DESIGN AND CONSTRUCTION OF GAS CONSUMING APPLIANCES.

Eastern.

O. H. Fogg, New York, N. Y., Chairman.

T. M. Ambler, Brooklyn, N. Y.
G. S. Barrows, Providence, R. I.
C. O. Bond, Philadelphia, Pa.
A. P. Brill, Pittsburgh, Pa.
Theo. Bunker, Newark, N. J.
W. M. Crane, New York, N. Y.
L. R. Dutton, Wyncote, Pa.
T. J. Litle, Jr., Gloucester, N. J.
J. P. MacSweeney, Rochester, N. Y.
G. T. Macbeth, Mt. Vernon, N. Y.
Sydney Mason, Gloucester, N. J.
H. K. Morrison, Lynn, Mass.
E. B. Myers, Philadelphia, Pa.
J. A. Norcross, New Haven, Conn.
P. F. Reichhelm, New York, N. Y.
C. V. Roberts, Philadelphia, Pa.
R. S. Scott, Baltimore, Md.
G. W. Thomson, Chester, Pa.
S. T. Willson, Brooklyn, N. Y.

Central.

G. R. Chamberlain, Grand Rapids, Mich., Chairman.

J. J. Burns, St. Louis, Mo.
G. W. Clabaugh, Omaha, Neb.
R. K. Clark, Chicago, Ill.
H. M. Eaton, Detroit, Mich.
H. C. Fritz, Cleveland, Ohio.
R. B. Harper, Chicago, Ill.
D. McDonald, Louisville, Ky.
G. W. McKee, Rockford, Ill.
H. D. Schall, Detroit, Mich.
G. Steinwedell, St. Paul, Minn.

Western.

C. N. Stannard, Denver, Colo., Chairman.

C. B. Babcock, San Francisco, Cal.
V. E. Britton, San Francisco, Cal.
J. C. D. Clark, Salt Lake City, Utah.
F. A. Cressey, Jr., Modesto, Cal.
H. H. Jones, San Diego, Cal.
G. Wehrle, Denver, Colo.

GAS FITTING AND APPLIANCE INSTALLATION.

EASTERN.

Wm. A. Wood, Boston, Mass., Chairman.

J. H. Braine, Brooklyn, N. Y.
W. A. Castor, Philadelphia, Pa.
C. M. Cohn, Baltimore, Md.
C. H. Dickey, New York, N. Y.
J. B. Douglas, Philadelphia, Pa.
A. E. Forstall, New York, N. Y.
W. G. Gribbell, Philadelphia, Pa.
A. H. Hall, New York, N. Y.
W. K. Harrington, New York, N. Y.
Frank Hellen, Rochester, N. Y.
W. D. Kelley, New York, N. Y.
R. M. Kellogg, Mt. Vernon, N. Y.
C. A. Learned, Meriden, Conn.
H. A. Norton, Boston, Mass.
Chas. Otten, Jr., Haverhill, Mass.
C. E. Paige, Malden, Mass.
F. A. Schobel, Albany, N. Y.
H. H. Sprague, Bridgeport, Conn.
P. S. Young, Newark, N. J.

CENTRAL.

Paul Doty, St. Paul, Minn., Chairman.

Horace H. Clark, Chicago, Ill.
J. W. Dunbar, New Albany, Ind.
LaRue B. Elliott, Chicago, Ill.
A. Hurlburt, Kansas City, Mo.
T. C. Jones, Delaware, Ohio.
Joseph Lucena, Omaha, Neb.
Carroll Miller, Aurora, Ill.
J. M. Morehead, Chicago, Ill.
A. A. Treadway, Detroit, Mich.
G. I. Vincent, Des Moines, Iowa.

WESTERN.

H. M. Papst, Portland, Ore., Chairman.

J. M. Berkley, Los Angeles, Cal.
W. J. Dorr, Los Angeles, Cal.
E. S. Jones, Sacramento, Cal.
J. D. Kuster, San Jose, Cal.
F. A. Leach, Jr., Oakland, Cal.
K. L. Simons, El Paso, Tex.
H. L. Strange, Honolulu, Hawaii.

THE PRESIDENT: Is there any discussion? What is your wish as to the disposition of the report?

MR. J. W. DUNBAR: I move the report be accepted and spread upon the minutes.

THE PRESIDENT: Those in favor say aye; opposed, no. It is carried.

We will now hear from the Committee on Revision of the Constitution, of which Committee Mr. Herman Russell is Chairman. In Mr. Russell's absence, will Mr. Brown present it?

MR. R. B. BROWN: Mr. President and gentlemen, with the approval of the Board of Directors, your Committee on Revision of the Constitution beg to offer the following amendment:

"Section 31-B: It shall be the duty of the Vice-President in each section to appoint on or before July 1, a Section Nomi-

nating Committee of three members of his Section, and to report to the Secretary of the Institute on or before July 15, the names of the members of such Section Nominating Committee, which shall be published in the number of the Gas Institute News for August, or separately if necessary."

Gentlemen, in asking the adoption of this amendment, I wish to say, it does not in any way change the present procedure except that this Nominating Committee which is now appointed at the first session of each sectional meeting, and has very little time to get into contact with the members of the Section, and to do their work intelligently will, under the amendment, be appointed months in advance of the meeting. Their names will be published to the members of the Institute, and suggestions as to nominations can reach them, and they will have ample time to carefully consider such suggestions and make, we believe, better nominations.

Mr. A. E. Forstall: I move that the Secretary be instructed to cast the ballot of the Institute for the amendment as proposed.

(Motion seconded and carried.)

Col. Pratt: Mr. President, I have to report that the motion to adopt the amendment of the Constitution as read, has been unanimously adopted.

The President: The next order of business is the question of B. t. u. At the meeting of the Board of Directors this subject was considered, and there is further business to report to the General Session. Mr. R. B. Brown will present it.

Mr. R. B. Brown: Mr. President and gentlemen, on behalf of your committee on B. t. u. standards, I will say that at a recent session of this Committee it was decided that we believe the Institute should more clearly define its stand on the question of B. t. u. standards than was done in the formal resolutions passed at the first session of this convention. With the approval of the Board of Directors, we offer the following, which, if approved by the Institute, we will ask to have

placed in the PROCEEDINGS after the formal resolutions in relation to B. t. u. standards adopted at the first session of this convention:

Experience has demonstrated that in establishing any definite calorific standard for gas, the following are conditions that govern:

1. In any calendar month gas should on the average at least meet the standard fixed.
2. Except in case of accident or other incident of manufacture reasonably beyond control, the average of any day's determinations should not fall below the standard fixed by more than 10 per cent.
3. Where gas is compressed the heating value shall be determined before compression.
4. Gas should not be required to contain such percentages of constituents as to render the gas unstable under varying conditions of atmospheric temperatures and pressures.
5. The standard adopted should not necessarily restrict the use of materials or processes to the detriment of economical manufacture or to prevent the conservation of natural resources.
6. Materials and processes may be used whose by-products of manufacture are of military value to the Government.

MR. JONES: Mr. President, I move that the report of the Board of Directors in relation to calorific standard be accepted and spread upon the minutes, with the approval of the American Gas Institute.

(Motion seconded.)

THE PRESIDENT: The question is now on the adoption of the motion as made by Mr. Jones. All in favor say aye; opposed, no. It is carried.

The next order of business is the report of the Section Vice-Presidents, the Chairmen of the Sectional sessions.

In the absence of Mr. Abell, Secretary Ramsdell will read the report of the Manufacturing Section.

THE SECRETARY: The report of the Manufacturing Section simply gives us the names of the men who are proposed for the Nominating Committee:

Your committee begs to submit the following nominations for Vice-President of the Manufacturing Section; one of these names to be selected by the General Nominating Committee at the next annual meeting:

J. H. TAUSSIG, Philadelphia;
A. B. MACBETH, Los Angeles;
DONALD MACARTHUR, Jersey City.

Respectfully submitted,

(Signed) J. A. BROWN,
J. P. KENNEDY,
A. F. TRAVER.

(Moved, seconded and carried that the report be received and filed.)

THE PRESIDENT: We will now have the report of the Distribution Section, presented by Secretary Ramsdell.

THE SECRETARY: The Distribution Section presents the following recommendations:

That a Committee on Industrial Fuel be appointed as outlined by Mr. Herman Russell.

That a Committee on the Design of House Heating Appliances be appointed to co-operate with the National Commercial Gas Association.

(On motion, the report was referred to the Board of Directors with power to act.)

THE PRESIDENT: Will Mr. Bond please present the report of the Illumination Section?

MR. BOND: The Illumination Section report unanimously for the following names for the Nominating Committee: Thomas E. Scofield, of New York; F. H. Gilpin, of Phila-

delphia, and C. A. Luther, of Chicago. No other action of the section was taken, except to recommend that the Committee on Gas Lighting be continued.

THE PRESIDENT: I think we will have to pass upon the report of this section inasmuch as it has a recommendation. A motion to dispose of this report is in order.

MR. J. P. CROWLEY: I move that the report be accepted, and the recommendation referred to the Board of Directors.

THE PRESIDENT: The motion is that the report of the Illuminating Section be received, and the recommendation be referred to the incoming Board of Directors.

(Motion seconded and carried.)

THE PRESIDENT: Mr. Harper, the Chairman of the Chemical Section will now present the report of that section.

MR. R. B. HARPER: The chief matter is the report of the Nominating Committee, which was sent in at yesterday's session. They have nominated the following:

R. B. HARPER, Chicago;
LEON B. JONES, San Francisco;
M. E. MUELLER, New York.

(Moved, seconded and carried that the report of the Manufacturing and Chemical Sections be received and spread on the record.)

THE PRESIDENT: The next business is the further report of the Distribution Section.

The American Gas Institute's specification for gas ranges and the American Gas Institute's specification for gas fixtures are the same as the specifications adopted by the National Commercial Gas Association. There is need for these specifications in pamphlet form, and, we therefore recommend to the Institute that an agreement be reached with the National Commercial Gas Association for the joint publication of these pamphlets under the titles, "Standard Gas Range Specifications Adopted Jointly by the American Gas Institute and the National Commercial Gas Association," and "Standard Gas

Fixtures Specifications Adopted Jointly by the American Gas Institute and the National Commercial Gas Association."

The character of these recommendations is such that I think the Institute might divide its action. The last one read is the recommendation to the Institute that an agreement be reached with the National Commercial Gas Association for the joint publication of these pamphlets. What is your pleasure with respect to this recommendation?

(Moved, seconded and carried that it be referred to the Board of Directors with power to act.)

THE PRESIDENT: The other two recommendations are that a Committee on Industrial Fuel be outlined, by the Chairman of the Manufacturing Section, in the discussion, and that a Committee on Design of House Heating Appliances be appointed.

What is your pleasure in respect to those motions?

(Moved, seconded and carried that both recommendations be referred to the Board of Directors with power to act.)

The next is the report of the Accounting Section.

MR. J. P. CROWLEY: I beg to report that the meetings of the Accounting Section were held on October 17th and 18th, in accordance with the program.

The committee appointed to recommend the names of three members of this Section as candidates for the office of Vice-President, reported the following names:

MR. EWALD HAASE, Milwaukee;
MR. G. W. CURRAN, Philadelphia;
MR. ROBERT GRANT, Boston.

This report the Section received and adopted unanimously; all of which is respectfully submitted.

MR. R. B. BROWN: I move that the report be received and placed on file.

THE PRESIDENT: It is moved and seconded that the report of the Accounting Section be received and spread upon the

minutes. Is there any discussion? If not, all in favor say aye; opposed, no. It is carried.

This disposes of the scheduled business of this general session of the Institute. Is there any other business to be brought before the meeting?

Mr. E. C. Jones (California): This has been an exceptionally pleasant and profitable meeting, Mr. President. In a large measure the success of the convention depends upon the initial plans and the steady hard work of the local committees. I would like to convey, on behalf of the American Gas Institute, to those good people, a sense of appreciation and the thanks of the Institute for the splendid contribution to our comfort and pleasure. Mr. E. G. Cowdery, Chairman of the Committee on Arrangements, has managed our entertainment and planned this convention with a skill which we all knew he possessed. He has had with him men who did splendid team work, as we know by the results obtained. The sub-committees have done excellent work, and particularly the registration bureau under Mr. Hohmann, has afforded us conveniences, and made it easier for us to transact our business, and we are thankful to him.

We are indebted also to the members of the Ladies' Reception Committee. Their work is of such a nature that we do not hear of it until we get to our homes. They take care of our dear ones while we are discussing gas, and I am sure from what I hear from the ladies that they have enjoyed every moment of their stay in Chicago.

There is another side to the work of the Reception Committees: From experience gained during the planning of the Tenth Annual Meeting of the American Gas Institute at San Francisco, in the year 1915, covering that year, and in making arrangements for the International Gas Congress, covering a period of almost 4 years, I find it is not work when one is devoting oneself to the pleasure, benefit and comforts of our fellow gasmen: It is a great pleasure; and if you could only realize how much pleasure we got out of doing, in our small way in California, what we could to add to the comfort and

pleasure of our visitors, you would say it was almost unnecessary to thank this splendid Committee of Arrangements which you have had here, for their excellent work. I know they are paid, as we Californians were, by the smiles on our faces and the visible evidence of our appreciation. (Applause.)

THE PRESIDENT: Mr. Jones' motion is abundantly seconded. I will ask those in favor to more signally manifest this by rising.

(All rise.)

Thank you, gentlemen. Be seated.

Is there any other business to be brought before this meeting? If not, we will adjourn.

(On motion of Mr. Macbeth, duly seconded, the convention adjourned.)

Convention adjourned.

In Memoriam

AUGUST 31, 1916

THOMAS P. KENNEDY,
Died May 13, 1915

C. PILZ,
Died May 17, 1915

CHARLES P. CUSHMAN,
Died September 29, 1915

DOUGLAS S. KNAUSS,
Died October 11, 1915

PATRICK O'MALLEY,
Died November 12, 1915

WILLIAM W. COLE,
Died December 20, 1915

AUGUSTIN J. DALY,
Died December 29, 1915

BENJAMIN W. PERKINS,
Died February 11, 1916

JOHN McILHENNY,
Died February 23, 1916

FREDERICK A. REILEY,
Died March 6, 1916

FREDERICK J. DOWN,
Died April 5, 1916

WILLIAM L. WILLIAMS,
Died April 16, 1916

HENRY FLOY,
Died May 5, 1916

SIR CORBET WOODALL,
Died May 17, 1916

THOMAS P. KENNEDY.

Thomas P. Kennedy, who died May 13, 1915, entered the employ of the Citizens Gas Light Company (now a part of the Brooklyn Union Gas Company) in October, 1889, as an office boy when sixteen years old. He progressed through various offices and on January 1, 1908, was appointed Superintendent of the Citizen's Works of the Brooklyn Union Gas Company which position he held at the time of his death.

Mr. Kennedy became an active member of the American Gas Institute in 1911.

C. PILZ.

Mr. Pilz, who was killed in battle, May 17, 1915, while serving in the German army, was a member of the American Gas Institute from 1907 until his death. He was the Secretary of the New York Lead Wool Company at the time he left for the war.

MR. CHARLES P. CUSHMAN.

Mr. Charles P. Cushman, whose death occurred while on a visit to this country, at the Biltmore Hotel, New York City, on September 28, 1915, was born at Lisbon, N. H., January 9, 1867. He was educated at Dartmouth College, being a member of the class of '89. He entered the gas business in 1890 as a clerk for the Lake Gas Company which was later consolidated with the Peoples Gas Light & Coke Company, Chicago, Ill. While engaged there he took up the study of law evenings and was admitted to the bar of Cook County. He remained with the Peoples Gas Light & Coke Company until the spring of 1904, when he accepted an important position with the Osaka Gas Company of Osaka, Japan. At the time of his death he was a director and vice-president of that company. The cause of his death was acute phlebitis.

Mr. Cushman was a man of unusual magnetic personality and was surrounded with a host of friends wherever he was located.

DOUGLAS S. KNAUSS.

Was born in Bethlehem, Pa., on February 14, 1890, and received his early schooling in the Moravian Parochial School. He entered the University of Illinois in 1907 taking a course in Mechanical Engineering, and graduated therefrom in 1911.

On July 3, 1911, he entered the Engineering Corps of The United Gas Improvement Company, being assigned to the Philadelphia Gas Works. He soon gave evidence of quick intelligent perception of the technical points involved in the manufacture of gas and by his studious habits and close application won the favorable notice of his superiors.

He joined the American Gas Institute in 1914 and contributed to the meeting a valuable paper on "A Suggested Extension of the Dewey Decimal Classification System to Gas Engineering."

During the course of erection of a portion of the residual plant with which Mr. Knauss had assisted in the technical calculations and in assembling of the parts, he fell from the top of a covered wooden tank to the floor beneath, sustaining injuries that thereafter resulted in his death in St. Agnes Hospital, October 11, 1915.

During the few years in which he assumed his serious work in life Mr. Knauss had won the respect of his fellow-workmen by his marked ability and the seriousness of his intentions.

Mr. Knauss at the time of his death was a Junior member of the Institute having been elected in 1914 as a cadet engineer of the United Gas Improvement Company.

PATRICK O'MALLEY.

Patrick O'Malley, who died November 10, 1915, was born in County Mayo, Ireland, in 1865. He came to this country when about sixteen years of age, and shortly after entered the employ of the Aurora Gas Light Company, Aurora, Ill.

He became Street Foreman and soon after was promoted to Superintendent of Works. As the company expanded, he was made Superintendent of Manufacture of all of the plants of the Western United Gas & Electric Company.

In 1912 he was appointed Superintendent of the by-product coke oven plant of the Coal Products Manufacturing Company, which position he held until forced on account of ill health to resign.

Mr. O'Malley became a member of the Western Gas Association in 1896 and a charter member in 1906 of the American Gas Institute.

WILLIAM W. COLE.

William W. Cole, a consulting engineer of New York City, died December 20, 1915. He was born in Medford, Mass., in 1868, and graduated from Worcester Polytechnic Institute in 1887. He became assistant engineer of the New England Construction Company which at that time was building water works in Newport. Later he was division engineer of the Toledo, St. Louis and Kansas City Railroad. He became widely known in his profession by his work in connection with the public service companies of Elmira. He was instrumental in consolidating the street railways, lighting companies and other properties into one utility corporation. In 1907 he became associated with Day & Zimmerman of Philadelphia, and as manager of the public utilities department, organized the Pennsylvania Central Light, Heat and Power Company and also was prominent in the reorganization of the Electric Light and Traction Company of Oil City.

Mr. Cole was a member of many technical societies, including the National Electric Light Association, and was for a time Vice-President of the Empire State Gas and Electric Association and the New York State Railways Association. He had also been President of the Rahway Valley Railroad. Mr. Cole was a charter member of the American Gas Institute.

AUGUSTIN J. DALY.

Augustin J. Daly, a charter member, died December 29, 1915, at Port Monmouth, N. J., when sixty-one years of age.

Mr. Daly entered the gas business when 18 years old in the fitting department of the Consolidated Gas Company of New York, and was made fitter foreman in 1873. He held the same position with the East River Gas Company and the New Amsterdam Gas Company from 1895 to 1903 at which time he went to St. Louis, Mo., as District Superintendent of the Laclede Gas Light Company which position he held until a short time before his death.

BENJAMIN WILTON PERKINS.

Benjamin Wilton Perkins, General Manager of the Hartford City Gas Light Company, Hartford, Conn., and the first President of the American Gas Institute, died after a short illness at his home in that city.

Benjamin Wilton Perkins was born in London, Eng., September 27, 1859, and died at Hartford, Conn., on February 11, 1916. He came to this country with his parents when 9 years old, settling at Cincinnati, Ohio. His father being a gas engineer, finally located at South Bend, Ind., where the son embarked in the gas business, rising step by step from the very beginning until he became Manager of the South Bend Gas Company, completing a service with that company of about thirty years. Ten years ago he moved to Altoona, Pa., and assumed the managership of the Altoona Gas Company. In May, 1910, Mr. Perkins was appointed General Manager of the Hartford City Gas Light Company, which position he filled with credit to himself and profit to the company. At the annual meeting of the company Mr. Perkins was reëlected General Manager.

He became a member of the Western Gas Association in 1889, the Ohio Gas Light Association in 1900, the Society of Gas Lighting in 1910, and the New England Association of Gas Engineers in 1915. He was elected President of the Ohio Gas Light Association in 1906 and was one of the Presidents of the three merging associations from which the President of the American Gas Institute was chosen, and became its first

President at the meeting in Chicago, October, 1906. He was the author of the editorial in the series of Past Presidents, which appeared in the February issue of the Gas Institute *News*.

JOHN McILHENNY.

Mr. John McIlhenny, senior partner of the firm of Helme & McIlhenny, died at his home in Germantown, Philadelphia, on February 23, 1916, in his 86th year.

In the early days of the manufacture of illuminating gas, Mr. McIlhenny was constructing engineer for the firm of Perdicaris & Hoy, of Philadelphia, and erected several gas plants in the South. He also operated the plant at Columbus, Ga., and while living there took an active part, as Mayor of the city, in restoring order after the close of the Civil War.

Prior to the war there were no public schools in Georgia, and Mr. McIlhenny and his wife, seeing the necessity of public education, drew the bills establishing the public school system of that State. Although Mr. McIlhenny had not lived in Georgia for 40 years, an industrial school in Columbus was recently named the "McIlhenny School," in recognition of his services for the children of that city.

In 1876 he returned to Philadelphia and became a member of the firm of Helme & McIlhenny, manufacturers of meters and gas appliances, of which firm he was the senior partner at the time of his death.

He was for many years a director of the Washington Gas Light Company, Washington, D. C.

Mr. McIlhenny all his life took an active interest in philanthropic and civic work. By cleaning up the city of Columbus and using oil on the surrounding pools he did away with mosquitoes, so that the city invited yellow fever refugees there at the time of the epidemic of 1873. In a cotton mill, of which he was owner, he established the first 10 hour day in Georgia, and in Philadelphia he was one of the first manufacturers to give the Saturday half-holiday to employees.

He was President of the Board of Trustees of the Second Presbyterian Church in Germantown.

Mr. McIlhenny became a member of the American Gas Light Association in 1875, and a charter member of the American Gas Institute in both of which he was a regular and active attendant.

FREDERICK ASBURY REILEY.

Frederick Asbury Reiley, Mechanical Engineer of the Waterbury (Conn.) Gas Light Company, died at his home in that city, March 6, 1916.

Mr. Reiley was the son of Mr. and Mrs. James M. Reiley, of Buffalo, N. Y. He was graduated from Cornell College in 1910 and went to Waterbury in 1913 as assistant to Mr. E. H. Williams and was placed in charge of the mechanical part of the plant. His illness was of short duration beginning with an attack of la grippe followed by complications which developed into spinal meningitis which caused his death.

Mr. Reiley became a Junior member of the American Gas Institute in 1914.

FREDERICK J. DOWN.

Frederick J. Down, a member of the Institute and one of the oldest employees of the Consolidated Gas Company of New York City, died April 5, 1916.

Mr. Down had quite recently been congratulated and honored by the company on his having completed fifty years in their employ.

In 1865, when seventeen years of age, he entered the employ of the Metropolitan Gas Company, and had progressed through various offices, until at the time of his death he was superintendent of the 42nd Street Station and had also supervision of the West 65th and East 63rd Street Distributing Stations, and was Vice-President of the National Coke and Coal Company.

He was one of the charter members of the Society of Gas

Engineering of New York City and one of its most active members. At their regular meeting, October 28, 1915, the members of this society took occasion to express to Mr. Down their congratulations and best wishes on the 50th anniversary of his coming with the company, presenting him with a gold watch testifying their respect and regard for him. Mr. George B. Cortleyou, President of the Consolidated Gas Company, made the presentation and in addition tendered to Mr. Down a testimonial from the directors and officers of the company in appreciation of his long and faithful service.

WILLIAM L. WILLIAMS.

William L. Williams died at his home in Paterson, N. J., April 16, 1916. Mr. Williams was for many years superintendent of the Passaic Division Public Service Gas Company, at his home in Paterson, N. J., and was one of the old residents of that city, and one of the oldest men in the gas business in the country. Mr. Williams was a man widely known to the gas fraternity, and in Paterson, where he had made his home for the last half century, he had a great many friends who will mourn his loss. Mr. Williams was eighty years old, and fifty-two of those eighty he spent in active service in the gas business. Nine years ago he was retired from active work on a pension.

He was born in Orange, N. J., on April 12, 1836, and was brought up to manhood in that town. He received his education in the village schools, and at the age of 19 years entered the gas business in Newark. In 1868 he went to Paterson to take charge of the works of the Paterson Gas Light Company. In 1882, when the United Gas Improvement Company leased the Paterson Gas Light Company and the People's Gas Light Company, Mr. Williams was placed at the head of the combined interests; and in 1899, when the Paterson and Passaic Gas and Electric Company was incorporated, he was made superintendent of the gas department of that company. In 1903 the plant was leased by the Public Service Corporation,

and from that time he was in charge until his retirement on a pension in 1907.

Mr. Williams became a member of the American Gas Light Association in 1890 and was a charter member of the American Gas Institute.

HENRY FLOY.

Henry Floy became a member of the American Gas Institute in 1915 as a Consulting Engineer at 165 Broadway, New York City. He was an electrical and mechanical engineer and was the first in his profession to install a 25,000 volt high tension electric transmission underground in that city, where he died, May 5, 1916, when 48 years of age.

Mr. Floy was born in Elizabeth, N. J., and after obtaining the degrees of A. B. and A. M. at Wesleyan University, he attended Cornell where he received the degree of M. E. in 1891. From then until 1898 he was employed by the Westinghouse Electric Company in Pittsburgh, Chicago and Minneapolis. He then came to New York City and was associated with Prof. R. C. Carpenter of Cornell, as a consulting engineer. Three years later he went into business for himself.

He was the author of several books on technical subjects which met with high favor in his profession and was a member of many engineering societies.

SIR CORBET WOODALL.

Sir Corbet Woodall was elected an honorary member of the American Gas Institute at the annual meeting in 1910 as an appreciation of his valuable services as a great leader, a great organizer, and as a great gas engineer and for the great impress his influence had made upon the gas industry of the world.

Personally a most modest man, Sir Corbet Woodall's accomplishments were such that for many years he had been engaged as a consulting gas engineer both at home and abroad, besides filling with remarkable efficiency important offices in gas com-

panies and gas organizations for which his business ability and wide experience, his knowledge of men and things, his sound judgment, breadth of view and frankness, his keen insight, grasp, diplomacy and power, coupled with the ceaseless application of his gifts, pre-eminently qualified him.

It would be difficult to name any prominent position in the gas industry which in his long and useful life he had not filled and with credit and while he is perhaps better known abroad for his valuable services as a consulting gas expert he took greater pleasure in his professional duties in his own country.

Above his professional attainments, however great the memory of Sir Corbet will be cherished for his breadth of sympathy, benign courtesy and delicate sense of honor, together with a Puritan conscience and a stern pursuit of its dictates made him a great personality and a noble man.

Sir Corbet was 75 years old and had but recently celebrated his golden wedding. He died May 17, 1916.

CONSTITUTION AND BY-LAWS

OF THE

AMERICAN GAS INSTITUTE

CONSTITUTION

NAME.

SECTION 1. The name of this Association shall be the American Gas Institute.

OBJECTS.

SECTION 2. The objects of this Institute are to amalgamate into one body the American Gas Light Association, the Ohio Gas Light Association, and the Western Gas Association, and to facilitate co-operation between the various state and district associations that now exist, or may hereafter be formed within the territory covered, and to secure thereby the more rapid promotion and advancement of scientific and practical knowledge in all matters relating to the construction and management of gas works, and the manufacture, distribution and consumption of gas; the firmer establishment and maintenance of a spirit of fraternity between those interested in the gas business by affording opportunity for social intercourse and friendly interchange of information and ideas; the inducement and extension of more cordial and friendly relations between gas companies and consumers of gas based upon their mutual interests, and the education of employees of gas companies to enable them to better perform their duties. Also to take over such property and assets of the associations named as may be legally invested in the Institute.

MEMBERS.

SECTION 3. The membership of the Institute shall consist of Honorary, Active, Junior, Associate and Affiliate Members. Honorary, Junior and Associate Members shall not be entitled to vote except in section meetings as provided in Section 39 hereof, nor to hold office, but shall be entitled to all other privileges of membership. Affiliate Members shall be entitled to attend and take part in all meetings of the sections and the Institute, but shall have no voting privileges, and shall receive publications of the Institute only as provided in Section 56.

SECTION 4. Honorary Members shall be persons whose scientific or practical knowledge in matters relating to the gas industry, and whose efforts and interests in that behalf shall recommend them to the Institute.

SECTION 5. To be eligible to Active Membership, a person must be at least 26 years of age, and be an officer or other employee of a gas company; or a consulting expert in some branch of the gas industry. He must be competent to act efficiently as the manager of a department of a Gas Company's business and must have his chief interest in the gas business directly connected with the manufacture, sale, or utilization of gas, and not the manufacture or sale of apparatus or appliances used by Gas Companies.

SECTION 6. To be eligible as a Junior Member, a person must be over 20 years of age and be in the employ of a Gas Company, or of a consulting expert in some branch of the gas industry, and must be qualified either by experience or education to hold a responsible position under such employers.

SECTION 6-B. A "Gas Company," as used in Section 5 and Section 6, shall be construed as including operating by-product coke oven companies or any other companies which are engaged in the manufacture, sale or distribution of gas, whether the distribution of its product is wholesale or retail.

SECTION 7. To be eligible as an Associate Member, a person must be engaged in a pursuit which constitutes a branch

of the gas industry, or be otherwise qualified to assist in promoting the objects of the Institute.

SECTION 8. To be eligible as an Affiliate Member, a person must be a member of an association affiliated with the Institute in accordance with Section 55.

ELECTION OF NEW MEMBERS.

SECTION 9. Candidates for Honorary Membership, if endorsed by not less than ten members of the Institute, in writing to the Board of Directors, shall be voted upon by the Board, and if receiving the unanimous vote of the Directors voting, shall be voted upon by the voting membership of the Institute not less than one year thereafter by a special mail ballot.

SECTION 10. Every application for either Active, Junior or Associate Membership shall be made to the Secretary in writing upon a form approved by the Directors, upon which shall be set forth as the grounds of the application, a complete account of the qualifications and experiences of the applicant and his agreement to conform, if elected, to the Constitution, By-laws and Rules of the Institute. Each applicant must be endorsed by at least two Active Members to whom he is personally known. The Secretary shall submit each application to the Membership Committee, who shall consider and act upon it and assign the applicant to the grade of membership to which, in their judgment, his qualifications entitle him. The name of each candidate thus approved by the Membership Committee, unless objection is made by the applicant, shall, after approval by the Directors, be submitted to the voting membership for election by means of a letter ballot. Every application for Affiliate Membership shall be accompanied by the dues and be endorsed by the Secretary of the affiliated association. Every applicant complying with these requirements shall be notified by the Secretary of his enrollment as an Affiliate Member.

SECTION 11. It shall be competent for any Junior, Associate or Affiliate Member to apply for transfer to another grade

of membership. The application for such transfer shall be made in the same manner as in the case of a new applicant.

SECTION 12. Election to membership shall be by a sealed letter ballot as the By-laws shall provide. Adverse votes to the number of 2 per cent. of the votes cast shall defeat the election of an applicant for any grade of membership. The Directors may, in their discretion, order a second ballot upon a defeated applicant, in which case adverse votes to the number of 4 per cent. of the votes cast shall be required to defeat the election.

SECTION 13. Any person elected to the Institute shall agree to comply with the requirements of the Constitution and, except in the case of Honorary Members shall pay to the Treasurer the initiation fee and one year's dues for his grade of membership before he can be entitled to the rights and privileges, or can receive a certificate of membership. If this requirement is not complied with within six months of the notification of the election, the applicant shall be deemed to have declined the election and the election shall be void.

INITIATION FEES AND DUES.

SECTION 14. The initiation fee for membership in each grade shall be as follows:

For Active Members	$10.00
For Associate Members	10.00
For Junior Members	5.00

The initiation fees shall not include the dues for the current year in which the applicant is elected.

SECTION 15. Any member on being transferred to any other grade of membership shall pay either the full initiation fee of the grade to which he is transferred or the difference between that initiation fee and the one he has already paid, except that Charter Junior Members shall not be required to pay such additional fee. No person shall retain Junior Membership for more than two years after becoming qualified for Active Membership.

SECTION 16. The annual dues, payable in advance, for membership in each grade shall be as follows:

For Active Members	$15.00
For Associate Members	15.00
For Junior Members	7.50
For Affiliate Members	2.00

SECTION 17. The Directors may in their discretion permit any Active or Associate Member to become a Life Member in the same grade by the payment in one sum of an amount sufficient to purchase from a reputable life insurance company an annuity on the life of a person of the age of the applicant equal to the annual dues in his grade of membership. Such life member shall not be liable thereafter for annual dues.

SECTION 18. The Directors shall have power by letter ballot to admit to Life Membership, without payment of a Life Membership fee, any person who for a long term of years has been an Active or an Associate Member, when, for special reasons, such an action would, in their judgment, promote the best interests of the Institute. Notice that such action is proposed shall have been given at a previous meeting of the Directors, and one dissenting vote shall defeat the proposed action.

SUSPENSIONS AND EXPULSIONS.

SECTION 19. Any member may retire from membership by giving written notice to that effect to the Secretary, and paying all dues to date, unless released from said payment by a vote of the Directors. A member whose dues for a year completely expired are not paid, shall not be entitled to vote, nor to participate in the deliberations of the Institute, nor to receive a copy of its publications. Any member whose dues shall remain unpaid for a term of three years may be dropped from the roll of membership by a vote of the Directors. A member dropped for non-payment of dues may, upon paying the amount he owes the Institute, be reinstated at the option of the Directors.

SECTION 20. The Directors may refuse to receive the dues of any member of any grade who shall have been adjudged by them to have violated the Constitution or By-Laws of the Institute, or who, in their opinion, shall have been guilty of conduct rendering him unfit to continue in its membership, and such person may be expelled from the Institute after notice and hearing by the Directors upon unanimous vote of the Directors present.

SECTION 21. The Directors may transfer any member from his then present to any lower grade of membership. They may also refuse to receive the dues of any member who is no longer eligible to any grade. No transfer of grade shall be made, or refusal to accept dues recorded, except upon notice from the Secretary, whose duty it shall be to give such notice, that said member is no longer eligible for membership in his then present grade, and that said member has for a period of ninety days after notification of such non-eligibility, failed to apply for transfer. The vote in each case shall be by ballot, and shall require two-thirds of the votes cast for its adoption.

MANAGEMENT.

SECTION 22. The affairs of the Institute shall be managed by the Directors, subject to the control of the general meeting.

SECTION 23. The Board of Directors shall consist of the President, the Vice-Presidents, the Secretary, the Treasurer, the Junior Past-President, and until changed as hereinafter provided for, ten Active Members of the Institute. Five members elected by the Institute shall constitute a quorum for the transaction of business. If arrangements are made for co-operation between the Institute and district and state gas associations, as hereinafter provided for, the number of members of the Board elected from the Active Members of the Institute shall be increased from time to time, as it becomes necessary, in order to keep the number of Directors elected by the Institute equal to not less than two-thirds of the total number of both Institute and Associate Directors.

SECTION 24. Should a vacancy occur in the Board of Directors or in any elective office, except that of President or Vice-Presidents, through death, resignation or other cause, the Directors may elect an Active Member to fill the vacancy until the next annual election.

SECTION 25. The Directors shall regulate their own proceedings, and may, by resolution, delegate specific powers to an Executive Committee, or to any one or more of their members. No act of the Executive Committee, or of a delegate, shall be binding until it has been approved by a resolution of the Directors.

SECTION 26. The Board of Directors shall present at the annual meeting of the Institute a report verified by the President, Secretary and Treasurer, or by a majority of the members, which shall show the state of the finances of the Institute at the date of the report; the receipts and expenditures for the fiscal year immediately preceding; the names and places of residence of the persons who have been admitted to membership in the Institute during that year, and give an account of the action taken by the Directors upon matters coming before them and recommendations as to the action to be taken by the Institute. This report shall be filed with the records of the Institute, and an abstract of it shall be entered in the minutes of the proceedings of the annual meeting.

SECTION 27. At each annual meeting there shall be elected from among the Active Members, a President, a Vice-President for each section into which the Institute is at the time divided, a Secretary, a Treasurer, and, until otherwise provided for, five directors. All of the officers shall be elected for one year except the Directors, who shall be elected for two years.

The Board of Directors may appoint annually and fix the salary of an Assistant Secretary. The Assistant Secretary shall represent and act in the place of the Secretary during the Secretary's absence or disability, and under the supervision of the Secretary shall perform such other functions or duties as the Board may authorize.

OFFICERS.

SECTION 28. All elections shall be by ballot.

SECTION 29. The term of all elected officers shall begin on the adjournment of the annual meeting of the Institute at which they were elected. Officers shall continue in their respective offices until their successors have been elected and have accepted such election.

SECTION 30. The President and the retiring Active Members of the Board of Directors shall not be eligible for re-election the following year.

SECTION 31. At least four months previous to each annual meeting, it shall be the duty of the Directors to appoint a Nominating Committee of five members, none of whom shall be a Director. It shall be the duty of this Nominating Committee to report to the Secretary on, or before, July 15, a list of the Active Members whom they recommend for election as Officers and Directors for the ensuing year. The Nominating Committee must select the Vice-President for each section from three Active Members, to be chosen by a majority vote of that section at the preceding annual meeting. The report of the Nominating Committee shall be published in full by the Secretary in the number of the Gas Institute NEWS for August, or separately, if necessary, at the discretion of the Secretary, and a copy of this number of the NEWS, or said separate circular, shall be mailed to each member entitled to vote not later than August 5. Immediately following the report shall be printed in full Section 32 of the Constitution.

SECTION 31-B. It shall be the duty of the Vice-President in each Section to appoint on or before July 1, a Section Nominating Committee of three members of his Section, and to report to the Secretary of the Institute on or before July 15, the names of the members of such Section Nominating Committee, which shall be published in the number of the Gas Institute NEWS for August, or separately, if necessary.

SECTION 32. Any twenty, or more, members entitled to vote may constitute themselves a Special Nominating Commit-

tee and may prepare a ticket in entire, or partial, opposition to the ticket prepared by the Nominating Committee, except that the nominee for Vice-President in each section must be selected from three Active Members, chosen by a majority vote of that section at the preceding annual meeting. Any such ticket shall be fully filled out with the names of the candidates for all the offices and positions of Directors to be filled at the approaching election, by inserting the names of the nominees of the regular Nominating Committee where there are no opposing candidates nominated. Any such ticket must reach the Secretary on or before September 15, and shall be published by him in full, together with the full list of members of such Special Nominating Committee, in the number of the Gas Institute NEWS for October, or separately, if necessary, at the discretion of the Secretary, and a copy of this number of the NEWS or such separate circular, shall be mailed to each member of the Institute entitled to vote not later than October 5. Only such tickets as may be nominated in accordance with Sections 31 and 32 shall be considered at the annual meeting.

SECTION 33. The Directors shall appoint from their own number immediately after the meeting at which they are elected a finance committee of three members.

SECTION 34. The President shall take the chair at all meetings of the Institute wherever the members meet as one body and of the Board of Directors. He shall be an *ex-officio* member of every committee and sub-committee. He shall determine to which general committee any matter shall be referred.

SECTION 35. In the absence of the President, one of the Vice-Presidents shall take the chair; if more than one Vice-President be present in the absence of the President, the Vice-President to preside shall be determined by lot, and in the absence of the President and Vice-President, a Chairman shall be appointed by the Directors from among their own number. Each Vice-President shall be the presiding officer of the section for which he was designated on nomination. He shall be *ex-officio* member of each committee relating solely to the work of his section.

SECTION 36. The Secretary shall be present at all meetings of the Institute and of the Board of Directors, and shall take and keep the minutes thereof. He shall conduct the correspondence of the Institute, read minutes and notices of all the meetings and also such papers and communications as are considered in the absence of their authors, and perform whatever other duties may be required of him by the Constitution and By-laws. There also shall be a Secretary for each section, to be appointed by, and having the same term of office, as the Chairman of the section. His duties shall be in general to assist in conducting the meetings of his section.

SECTION 37. The Treasurer shall collect and have charge of all funds of the Institute. He shall pay all bills approved by the President and a member of the Finance Committee, and shall keep book accounts of all receipts and expenditures. He shall make an annual report.

SECTION 38. The duties of the Finance Committee shall be to audit the books, accounts and statements of the Treasurer; to invest the funds of the Institute, and to care generally for the finances of the Institute, subject to the control of the Directors.

SECTION 39. The duties of the Directors shall be to have the general management of the affairs of the Institute, and to prepare for its meetings. No paper or report that has not had the approval of the Directors shall be read at any meeting of the Institute or any section thereof.

The Directors shall have the power to appoint, from time to time, a Committee on Arrangements from among the members, to assist the Directors in arranging for the meetings of the Institute. The Directors shall have power to provide for the voluntary division of the membership into two or more sections for the choice of sectional Vice-Presidents and for the hearing and discussion of papers and reports. The functions and powers of each section shall be limited to the nomination of a Vice-President, the provision and consideration of papers and reports, the reference to committees, and to recom-

mendations to the Institute or to the Board of Directors. Any member of the Institute may attend the meeting of any section at any time. Any Honorary, Active, Associate or Junior member in good standing may vote on the election of section officers or on other matters connected with section organization in one section only, and to so vote must register as a voting member of such section. He may change this registration on one year's notice to the Secretary of the Institute, provided that this notice be waived in the case of each member making application to form a new section.

Upon the written application to the Directors of any thirty members of the Institute asking for the creation of a new section, the Directors shall proceed to form the section applied for.

Any resolution, report or recommendation that has not been considered and approved by the Directors, and that in the opinion of the Chair would have the effect of changing the policy of the Institute, or committing it to any new policy or opinion to which it had not theretofore been committed, shall be referred, before adoption, to the Board of Directors, whose duty it shall be to report to the next regular meeting of the Institute upon such committal, if any, and its proper phrasing.

Section 40. There shall be two general committees, each reporting to the Board of Directors and responsible to the Board for such part of the work of the Institute as is delegated to it in accordance with Sections 34, 41 and 42. Each committee shall be composed of at least six members, appointed each year by the President after the annual meeting, to serve one year.

Section 41. One general committee shall be called the Public Relations Committee, and to it shall be referred all investigations, reports, recommendations, resolutions and matters of any kind affecting the relations between the Institute, or its members, and the public, or any governing bodies, except as herein provided.

SECTION 42. One general committee shall be called the Technical Committee, and to it shall be referred all investigations, reports, recommendations, resolutions and matters of any kind having to do with the construction, operation and extension of gas works, and the conduct of the affairs of gas companies, not specifically delegated to the Public Relations Committee by Section 41, and except as herein otherwise provided. Each section shall have a representative on this Committee.

SECTION 43. Each general committee shall have the power to appoint sub-committees. Any sub-committee may be appointed from the general membership of the Institute, and shall exist at the pleasure of the general committee by which it was appointed, and to which its report shall be made.

MEETINGS AND PROCEEDINGS.

SECTION 44. The annual meeting of the Institute shall be held on the third Wednesday of October of each year, at such place as shall be designated by the Institute at the previous meeting. In case of emergency, the Directors shall have the power to change the time or place of meeting, or both, as so designated, by a three-fourths vote of all its members, at the call of the President, and such vote may be taken by mail.

SECTION 45. The Secretary shall send notices to all members of the Institute at least fourteen days before each general meeting, mentioning the papers to be read and any special business to be brought before the meeting. During a recess in any meeting of the Institute, taken in order that section meetings may occur, no meeting of the Institute other than as provided at the time the recess is ordered shall be held until one hour after a call for such meeting has been read in each section meeting in session at the time, and has been posted on the official bulletin board. The President shall have the authority to issue such call, and it shall be obligatory to him to issue such call on the written request of fifty members.

SECTION 46. Special meetings of the Institute may be called at the option of the Directors, and the Secretary shall

call a special meeting on the written request of one hundred members. The notices for special meetings shall be sent to all members at least three weeks before the date for which the meeting is called, and shall state the business to be transacted, and no other shall be entertained.

SECTION 47. Thirteen members shall constitute a quorum.

SECTION 48. All questions, except as otherwise provided in Sections 9, 20, 28, 49 and 57, shall be decided by any convenient system of open voting, the presiding officer to have a second or casting vote when necessary.

SECTION 49. Questions of a personal nature shall be decided by ballot and all parliamentary procedure not specifically covered by this Constitution shall be governed in accordance with Roberts' Rules of Order.

SECTION 50. Any member, with the concurrence of the presiding officer, may admit a friend to each meeting of a section or of the Institute, but such person shall not take part in any of the discussions unless permission to do so be given by the meeting.

SECTION 51. All papers read at the meetings of the Institute must relate to matters either directly or indirectly connected with the objects of the Institute.

SECTION 52. All papers, drawings or models submitted to the meetings of the Institute shall be and remain the property of the authors.

SECTION 53. The President, the Junior Past-President, the Junior Past-Chairmen of the two general committees, and the Secretary shall constitute a Publication Committee, and nothing shall be included in the published reports of the Institute's proceedings, or in any other publications issued by its authority, that has not been approved by at least three-fifths of the full membership of the Publication Committee.

SECTION 54. The Directors shall meet the day before each general meeting of the Institute, and also on such days between June 1 and September 15, both inclusive, as may be

designated by the President, by notice given at least one week in advance of meeting. Special meetings may be called when the President shall deem it necessary, and the President shall be required to call a special meeting at any time on the written request of five members of the Board. Of such meetings reasonable notice shall be given by special call, in print or writing, specifying the business to be attended to.

GEOGRAPHIC AND DISTRICT SECTIONS.

Section 55. The Board of Directors may in its discretion make with any gas, electric or gas and electric association, an affiliation agreement, upon such terms as may be mutually agreed upon, providing the membership or objects or interest of such association are not in conflict with those of the Institute. An affiliation agreement shall provide for the termination of such agreement on twelve months' notice by either party.

An affiliation agreement may provide for representation of the affiliated association on the Board of Directors of the Institute, but in such cases said association shall at no time have more than 20 per cent. of its voting membership persons not directly identified with gas or electric interests within the state or district designated by the name of the association; and said association shall agree to present the result of work of interest in the form of a report to the Board of Directors of the Institute; such affiliated Associate Directors shall be additional to the Institute Directors provided for in Section 23, and shall at no time exceed one-third of the total.

On all matters pertaining to public relation, the Institute and the affiliated association shall agree to co-operate, and the latter shall consult with and be advised by the Public Relations Committee before taking official action on these matters. The services of the Public Relations Committee shall be available to the affiliated association in return for payment of actual expenses incurred.

Upon request of the affiliated association the Technical Committee will co-operate in all matters within its province.

Abstracts of papers presented to the affiliated association will, after approval by the Technical Committee, be published in the NEWS, as will complete papers undertaken by agreement with the Technical Committee.

PUBLICATIONS.

SECTION 56. With the exception of Affiliate Members, each member of the Institute in good standing shall be entitled to and shall be furnished by the Secretary with a copy of the PROCEEDINGS of the Institute for the current year, in which shall be listed the names and addresses of the members. In any such list, each member shall be listed by the title, or titles, only, from which he derives his eligibility to his class of membership. Affiliate Members shall, in return for their dues, receive the Gas Institute NEWS, and at members' prices, any other publications of the Institute.

SECTION 57. Any proposition for adding to or altering any of the provisions of the foregoing Constitution shall be laid before the Directors, who, if they see fit, may bring it before the next general meeting of the Institute, and who shall be bound to do so on the requisition in writing of any ten members of the Institute. All such propositions shall be decided by ballot and shall require two-thirds of the vote cast for their adoption.

BY-LAWS.

(Section numbers in parentheses refer to the Constitution.)

1. (Section 10.) Each member proposing a candidate for admission is required to make a confidential communication to the Secretary for forwarding to the Membership Committee, setting forth in detail such information, personally known to referee, as shall enable the Directors to decide upon the eligibility of the candidate for admission to the Institute, except that in the event of the requisite number of members in good standing having personally signed the application of a candidate, this may be deemed sufficient endorsement, and the requirement of the confidential communication referred to above shall not be obligatory, but shall be optional at the discretion of the Membership Committee. The Secretary shall be the judge of the competency and the signature of referees.

2. (Section 10.) In the absence of replies from the referees to inquiries for information, or if replies are not sufficiently explicit, the Secretary shall cause the applicant to be notified, and the application shall be held in abeyance.

3. (Section 10.) At a meeting subsequent to their election, the Directors shall appoint from their number, four, to be a committee on election of new members. This committee shall pass on all applications for membership, and report to the Directors. Any correspondence in regard to an applicant shall be destroyed when his name has been placed upon a voting ballot, or upon withdrawal of the application.

4. (Section 12.) The Secretary shall, twice a year, on or about the first day of March and of September, mail to each member entitled to vote, a ballot stating the names and respective grades of the candidates for membership in the Institute which have been approved by the Directors, and the time of the close of voting. The voter shall prepare his ballot by crossing out the names of candidates rejected by him, and shall enclose said ballot in a sealed blank ballot envelope, which he shall then enclose in a second sealed outer envelope

on which he shall, for identification, write his name in ink. The ballot thus prepared and enclosed shall be mailed or delivered unopened to the Secretary, which shall be counted as an affirmative vote on all the names not crossed out. The Secretary shall be the judge of the competency and the signature of all voters. On the close of the voting, the Secretary shall first open and destroy the outer envelopes, and shall then canvass the ballots, and certify the result to the Membership Committee.

The Secretary shall not receive any ballot after the stated time of the close of voting. A ballot without the endorsement of the voter, written in ink on the outer envelope, shall be considered as defective, and rejected by the Secretary.

The names of those persons elected to membership, with their respective grades, shall be embodied in a written report, signed by the Secretary, and presented to the next meeting of the Institute. The President shall then declare them duly elected to membership in the Institute. The Secretary may, in advance of any meeting, advise each candidate of the result of the canvass of the votes in his case. The names of applicants who are not elected shall neither be announced nor recorded in the PROCEEDINGS.

The endorser of an applicant who has not been elected, may, with his consent, present to the Directors a written request for a re-submission of his name to ballot. The Directors may, in their discretion, by a three-fourths vote of the members present, order the name of the applicant placed on the next ballot for members.

5. (SECTION 13.) Section 13 of the Constitution shall be printed upon the notification of election to all members except Honorary Members.

6. (SECTIONS 14 and 16.) The initiation fee and annual dues for the first year shall be due and payable on notice of election to membership. Bills for the fee and dues should accompany the notification of election. Thereafter the annual dues shall be due and payable on the first day of September of each year.

7. (Sections 14 and 16.) Upon payment of the initiation fee and annual dues, a newly elected member shall receive copies of any publications of the Institute, which may have been distributed without charge to the members during that year, even though the date of issue of these publications is prior to that of the election of such member.

8. Each member shall be entitled to a badge upon payment of an amount to be fixed from time to time by the Directors. Upon his ceasing to be a member, he shall return his badge, and receive therefor the sum of $2.00.

9. Each member shall be entitled to a certificate of membership in accordance with his grade, signed by the President and Secretary. Every such certificate shall remain the property of the Institute, and shall be returned to the Secretary on demand of the Directors.

10. (Section 19.) The Treasurer shall present to the Directors the name of any member in arrears for more than one year.

11. (Section 20.) At least one month's notice shall be given to the Directors and to the member who is to be heard.

12. (Section 26.) The Secretary shall furnish the Directors with the information needed for their annual report, excepting only as to finances, or to matters which have been entrusted to special committees. The financial report shall be made by the Treasurer to the Finance Committee.

13. (Section 26.) The fiscal year of the Institute shall begin September 1.

14. (Section 28.) The President shall, at the first session of the Annual Meeting, appoint three Tellers of Election, who shall canvass the vote cast for officers, and report the result to the meeting.

15. (Section 31.) The Nominating Committee shall report at the first session, and a ballot be taken on their report at once unless twenty or more members object. In such case, the ballot for officers shall take place at the first session of the second day, in the manner prescribed in By-law No. 15.

16. (Section 31.) If the report of the Nominating Committee is not unanimously adopted, the Tellers of Election shall distribute ballots among the members at once, unless the election is postponed, as covered by By-Law No. 14. In either case, poll may be opened outside the meeting room in some adjacent and convenient place. If there is no objection, one ballot may be cast for those nominated by the committee.

17. (Section 33.) When the appointment of a chairman is not included in the appointment of a committee, the latter shall elect their own chairman.

18. (Section 36.) The Secretary shall be in charge of the membership lists. He shall also be in charge of all other property of the Institute not distinctly pertaining to the Treasurer's work.

18*b*. (Section 36.) Immediately after each annual meeting of the Institute the Secretary shall compile a list of all matters referred by the Institute at that meeting to the Board of Directors for consideration, and shall present this list to the Board at its next meeting.

19. (Section 37.) The annual report of the Treasurer shall be embodied in the financial report of the Directors.

20. (Section 37.) Neither the Treasurer nor any other officer of the Institute shall pay out money except upon bills approved by the President and a member of the Finance Committee.

21. (Section 37.) The Treasurer shall furnish a bond for the faithful performance of his duties to such amount as the Finance Committee may require, such bond to be procured from an incorporated guarantee company at the expense of the Institute.

22. (Section 39.) The President, subject to subsequent approval by the Directors, may, in his discretion, appoint a member or members of the Institute to represent it at meetings of associations of kindred aim or at public functions. Such delegates should be designated as "Honorary Vice-Presidents," and their duties shall terminate with the occasion for which they are appointed.

23. (SECTION 39.) Not later than six months prior to each annual meeting of the Institute, the Directors shall appoint an Arrangement Committee to have charge of all the details connected with the annual meeting, except only as to papers.

24. (SECTION 39.) The voting lists for section matters shall be drawn up from the list of members as published in the last volume of the PROCEEDINGS, in which the section registration of each member shall be shown.

25. (SECTION 44.) The President shall appoint a committee of three to recommend the place for the next annual meeting, which committee shall report to the Board of Directors at the meeting of the Board next following the adjournment of the next Annual Meeting.

26. (SECTION 57.) Amendments of, or additions to, the By-Laws may be adopted by the Directors by a unanimous vote at any meeting. When objection is made, two weeks' notice and copy of the proposed changes shall be sent to each Director. At any meeting subsequent to such notice, a two-thirds vote will be sufficient for adoption.

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MEMBERS

OF THE

AMERICAN GAS INSTITUTE

HONORARY MEMBERS.

BONE, PROF. WILLIAM A., September, 1912.
Professor in the Imperial College of Science and Technology, South Kensington, London, S. W., England.

CHANDLER, CHARLES F., PH. D., M. D., LL. D., D. Sc., September, 1910.
51 East 54th Street, New York, N. Y.

KING, WILLIAM, September, 1910.
5 Beach Lawn, Waterloo, Liverpool, England.

LIFE MEMBERS.

EGNER, FREDERIC, October, 1906.
Consulting Engineer, Retired, 516 Quincy Street, N. W., Washington, District of Columbia.

SLATER, ALPHEUS B., October, 1906.
Consulting Engineer, Slocums, Rhode Island.

ACTIVE MEMBERS.

ABELL, H. C., October, 1906. (P)
Engineer, American Light & Traction Company, 120 Broadway, New York, New York.

ADAMS, H. C., October, 1906.
Vice-President, Westmoreland Coal Company, 224 South Third Street, Philadelphia, Pennsylvania.

ADAMS, OLIVER WINCHESTER, September, 1914.
Superintendent, Holyoke Gas Works, City Hall, Post Office Box 218, Holyoke, Massachusetts.

ADDICKS, WALTER R., October, 1906. (P)
Vice-President, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

AFRICA, WALTER G., October, 1906. (P)
Treasurer and Manager, Peoples Gas Light Company, 39 Hanover Street, Manchester, New Hampshire.

P = Present at Chicago Convention.

ALDEN, CHARLES ARTHUR, March, 1916.
Assistant Auditor, Boston Consolidated Gas Company, 111 Devonshire Street, Boston, Massachusetts.

ALDEN, JOHN DOUGLAS, March, 1910.
Assistant, Bronx Gas & Electric Company, 1520 Overing Street, Westchester, New York.

ALLEN, ARTHUR BENJAMIN, March, 1914.
Assistant Superintendent, New York Mutual Gas Light Company, 825 East 11th Street, New York, New York.

ALLEN, WILLIAM H., JR., September, 1909. (P)
Superintendent, By-Products Coke Corporation, Semet-Solvay Coke Ovens, 332 South Michigan Avenue, Chicago, Illinois.

ALLISON, WALTER A., October, 1906.
Engineer, 403 Wister Street, Philadelphia, Pennsylvania.

ALLYN, GEORGE E., October, 1906.
Superintendent of Distribution, Providence Gas Company, Turks Head Building, Providence, Rhode Island.

ALMBERG, H. E., September, 1913.
Attorney for Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

ALMERT, HAROLD, September, 1916.
Consulting Engineer, 209 South LaSalle Street, Chicago, Illinois.

ALRICH, HERBERT W., March, 1909. (P)
Assistant Engineer of Construction, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

ALTHEN, GEORGE R., September, 1912. (P)
General Supt. of Distribution, Gas Division, Consolidated Gas, Electric Light & Power Co., 1068 N. Front St., Baltimore, Md.

ALTHOUSE, A. J., September, 1912.
Superintendent, Hamburg Gas & Electric Company, Hamburg, Pennsylvania.

AMBLER, THOMAS MARSHALL, September, 1914. (P)
Manager, Commercial Department, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

AMES, KNOWLTON L., October, 1906.
Jacksonville Gas Company, 108 South LaSalle Street, Chicago, Illinois.

Andersen, Howard Bruce, September, 1911.
Superintendent City District, The United Gas Improvement Company, 1931 South 9th Street, Philadelphia, Pennsylvania.

Andrews, Charles Harold, March, 1912.
Assistant General Manager, North Carolina Public Service Company, Greensboro, North Carolina.

Andrews, C. W., October, 1906.
Treasurer, Zenith Furnace Company, 404 West First Street, Duluth, Minnesota.

Andrews, J. Charles, October, 1906.
Turner Construction Company, 11 Broadway, New York, New York.

Angell, Frederic J., September, 1908.
Mechanical Engineer, 38 Victoria Street, Westminster, London, S. W., England.

Arkwright, P. S., October, 1906.
Vice-President, Atlanta Gas Light Company, Electric & Gas Building, Atlanta, Georgia.

Armstrong, H. V., March, 1912. (P)
Superintendent, Gas Department, Northern Indiana Gas & Electric Company, Michigan City, Indiana.

Armstrong, J. H. N., March, 1911. (P)
Statistician, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Ashworth, James, September, 1910.
Superintendent of Distribution, Public Service Gas Company, St. Paul and St. James Avenues, Jersey City, New Jersey.

Ayres, Chester T., September, 1908.
Works Manager, Union Carbide & Electro-Metallurgical Company, 30 East 42d Street, New York, New York.

Baehr, William Alfred, October, 1906. (P)
Consulting Engineer, Peoples Gas Building, Chicago, Illinois.

Bain, Ferdinand R., September, 1914.
President, Southern Counties Gas Company, 616 Title Insurance Building, Los Angeles, California.

Bains, George B., 3d, October, 1906.
Engineer, Consumers Gas Company, 441 Penn Street, Reading, Pennsylvania.

Baker, Frank J., March, 1916. (P)
Vice-President, Public Service Company of Northern Illinois, 72 West Adams Street, Chicago, Illinois.

Ball, James, October, 1906.
Assistant Secretary and Treasurer, United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Ball, Samuel, September, 1911.
Manager, Bay City Gas Company, 520 Centre Avenue, Bay City, Michigan.

Barker, Perry, September, 1911.
Fuel Engineer, Arthur D. Little, Inc., 141 Milk Street, Boston, Massachusetts.

Barker, William S., September, 1911.
Assistant Treasurer, Public Service Gas Company, 763 Broad Street, Newark, New Jersey.

Barlow, Thaddeus Scott, September, 1910.
Superintendent, Consolidated Gas Company, 302 East 99th Street, New York, New York.

Barnes, Albert Mallard, September, 1907. (P)
President and General Manager, Cambridge Gas Light Company, 719 Massachusetts Avenue, Cambridge, Massachusetts.

Barnitz, Frank R., September, 1908.
Assistant Secretary, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Barnum, Dana Dwight, March, 1911. (P)
President and General Manager, Worcester Gas Light Company, 240 Main Street, Worcester, Massachusetts.

Barrett, William E., October, 1906.
Gas Engineer, Room 1902, 43 Exchange Place, New York, New York.

Barrett, William Felton, September, 1908. (P)
Consulting Engineer, 42d Street Building, 30 East 42d Street, New York, New York.

Barrows, George S., October, 1906. (P)
Manager, Gas Heating Department, General Fire Extinguisher Company, 275 West Exchange Street, Providence, Rhode Island.

Bartel, Emil Joseph, September, 1916. (P)
Superintendent, Meter Repair Department, Brooklyn Union Gas Company, 62 Twelfth Street, Brooklyn, New York.

Barthold, W. H., October, 1906. (P)
Gas Engineer, Hodenpyl, Hardy & Company, 14 Wall Street, New York, New York.

Batten, J. W., March, 1909. (P)
Engineer, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

Battin, Henry S., October, 1906. (P)
Assistant to General Superintendent, United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Baurhyte, William, October, 1906.
First Vice-President, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

Baxter, Isaac C., October, 1906.
Upland, San Bernardino County, California.

Bayly, C. Clay, October, 1906.
Assistant to Engineer, Washington Gas Light Company, 413 Tenth Street, N. W., Washington, District of Columbia.

Beadenkopf, George, October, 1906. (P)
Chief Engineer, Consolidated Gas, Electric Light & Power Company, Lexington and Liberty Streets, Baltimore, Maryland.

Beadle, Albert B., October, 1906.
Consulting Gas Engineer, 1328 Chestnut Street, Philadelphia, Pennsylvania.

Beal, A. R., October, 1906. (P)
Contract Agent, Central Hudson Gas & Electric Company, 129 Broadway, Newburgh, New York.

Beal, T. R., October, 1906.
President, Central Hudson Gas & Electric Company, 50 Market Street, Poughkeepsie, New York.

Beardsley, Alling P., September, 1915.
Chemist, Cott-a-lapp Company, Somerville, New Jersey.

Beaumont, Walter W., September, 1907.
Superintendent of Transportation, The United Gas Improvement Company, 4650 Market Street, Philadelphia, Pennsylvania.

Beck, George W., October, 1906.
Superintendent, Northumberland County Gas & Electric Company, Sunbury, Pennsylvania.

Bell, Ernest William, October, 1906.
Consulting Engineer, 14 Wall Street, New York, New York.

Benedict, Clarence, M., September, 1908.
Assistant Secretary and Treasurer, Charleston Consolidated Railway & Lighting Company, Charleston, South Carolina.

Bennett, Charles W., October, 1906. (P)
Assistant General Manager, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

Bennett, Orville Grant, March, 1914.
Assistant Treasurer, Northern Westchester Lighting Company, 127 Main Street, Ossining, New York.

Benson, Frederick Shepard, Jr., March, 1911.
Superintendent, Nassau Works, Brooklyn Union Gas Company, 556 Kent Avenue, Brooklyn, New York.

Berkley, Jos. M., October, 1906.
Superintendent and Engineer, Southern California Edison Company, Edison Building, Los Angeles, California.

Bertke, William John, October, 1907. (P)
Engineer, Sioux City Gas & Electric Company, 3519 Jackson Street, Sioux City, Iowa.

Bertrand, Philip A., October, 1906.
General Manager, Grays Harbor Railway & Light Company, Electric Building, Aberdeen, Washington.

Besson, William C., March, 1915.
Treasurer, New York Mutual Gas Light Company, 142 East 15th Street, New York, New York.

Beugler, Hugh M., September, 1913.
Operating Manager, Central Hudson Gas & Electric Company, 50 Market Street, Poughkeepsie, New York.

Bigelow, William Russell, September, 1916. (P)
Chief Chemist, Coal Products Manufacturing Company, Joliet, Illinois.

Bill, Benjamin P., October, 1906.
Superintendent, Springfield Gas Light Company, 23 State Street, Springfield, Massachusetts.

Bimson, John, Jr., September, 1909.
Superintendent Distribution, Public Service Gas Company, East 5th Street, Paterson, New Jersey.

Bird, Viggo Edward, September, 1910.
Manager, New London Gas & Electric Division, Connecticut Power Company, 33 Union Street, New London, Connecticut.

Bishop, Rookwood Comfort, March, 1911.
General Manager, Christchurch Gas, Coal & Coke Company, Ltd., 77 Worcester Street, Christchurch, New Zealand.

Bissell, West, October, 1906.
Civil Engineer, Care of Mrs. Kennedy, 27 Park Street, Jersey City, New Jersey.

Blackie, John F., March, 1911. (P)
Superintendent, Milwaukee Coke & Gas Company, First National Bank Building, Milwaukee, Wisconsin.

Blackwell, Hubert C., September, 1912. (P)
General Manager, Peoples Light Company, 125 West 3d Street, Davenport, Iowa.

Blanquier, Juan, September, 1916.
Chief Engineer, Santiago Gas Company, San Miguel 72, Santiago, Chile.

Blauvelt, Warren S., October, 1906. (P)
Consulting Engineer, Steere Engineering Company, Woodward and Horton Avenues, Detroit, Michigan.

Blauvelt, William Hutton, March, 1911.
Consulting Engineer, Semet-Solvay Company, 1917 West Genesee Street, Syracuse, New York.

Blossom, Francis, September, 1916.
Member Firm Sanderson & Porter (Engineers), 52 William Street, New York, New York.

Blowers, Frank W., October, 1906.
Vice-President and General Manager, Kalamazoo Gas Company, Kalamazoo, Michigan.

Boardman, A. E., October, 1906.
Hotel du Parc, Locarno, Switzerland.

Boardman, Clark Clinton, September, 1916. (P)
Superintendent of Distribution, Westesn United Gas & Electric Company, Aurora, Illinois.

Bodine, Samuel Taylor, October, 1906.
President, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Bond, Charles O., March, 1907. (P)
Manager, Photometrical Laboratory, United Gas Improvement Co., 3101 Passyunk Avenue, Philadelphia, Pennsylvania.

Boone, Charles, October, 1906.
Engineer, Metropolitan Works, Brooklyn Union Gas Company, 12th Street and Gowanus Canal, Brooklyn, New York.

Booth, Arthur, September, 1909.
Assistant General Purchasing Agent, Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

Booth, W. F., March, 1909.
Manager, Little Rock Gas & Fuel Company, 624 Louisiana Street, Little Rock, Arkansas.

Borden, Albert Wells, September, 1914. (P)
Vice-President and Manager, The Hastings Gas Company, 302 Lincoln Avenue, Hastings, Nebraska.

Borgner, Cyrus, October, 1906. (P)
President, Cyrus Borgner Company, 234 North Twenty-third Street, Philadelphia, Pennsylvania.

Boyd, Albert Matthew, October, 1906. (P)
Assistant to General Superintendent, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Bradley, Charles W., October, 1906. (P)
Gas Engineer, Public Service Company of Northern Illinois, 72 West Adams Street, Chicago, Illinois.

Bradley, Wallace H., September, 1914. (P)
Manager, Springfield Gas Light Company, State and Water Streets, Springfield, Massachusetts.

Bradley, William H., October, 1906.
Chief Engineer, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Brady, James C., March, 1907.
Director, New Amsterdam Gas Company, 54 Wall Street, New York, New York.

Braine, John H., October, 1906.
Superintendent, Holder Distribution Department, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Brandli, Henry Edward, September, 1916.
Treasurer and General Manager, Citizens Gas, Electric & Heating Company, Mount Vernon, Illinois.

Bratton, Samuel Connor, September, 1916.
Commercial Manager, Portland Gas & Coke Company, 5th and Yamhill Streets, Portland, Oregon.

Brewer, Joseph H., September, 1912.
Vice-President, Kelsey & Brewer Company, Grand Rapids Savings Building, Grand Rapids, Michigan.

Britsch, Mathias, October, 1906.
Superintendent, Public Service Company of Northern Illinois, Lombard Avenue and G. W. Tracks, Oak Park, Illinois.

Britton, John A., October, 1906.
Vice-President and General Manager, Pacific Gas & Electric Company, 445 Sutter Street, San Francisco, California.

Britton, John A., Jr., March, 1915.
Assistant Engineer, Gas Department, Pacific Gas & Electric Company, 13th and Clay Streets, Oakland, California.

Britton, Van Leer Eastland, September, 1914.
Assistant Engineer, Gas Department, Pacific Gas & Electric Company, 7th and Market Streets, San Francisco, California.

Brodnax, Wm. F., October, 1907.
14 Eighth Avenue, Bethlehem, Pennsylvania.

Brown, Charles H., September, 1912.
Superintendent, Suffolk Gas-Electric Company, 1003 West Washington Street, Suffolk, Virginia.

Brown, Ernest C., October, 1906. (P)
Secretary and Treasurer, Boone (Iowa) Gas Company, Editor, *The Gas Age,* 52 Vanderbilt Avenue, New York, New York.

Brown, James A., September, 1911. (P)
Gas Engineer, Consumers Power Company, 214 West Main Street, Jackson, Michigan.

Brown, R. B., October, 1906. (P)
General Manager and Chief Engineer, Milwaukee Gas Light Company, 182 Wisconsin Street, Milwaukee, Wisconsin.

Brown, Robert E., October, 1906.
General Manager, Consumers Power Company, 132 South Front Street, Mankato, Minnesota.

Brown, Samuel W., September, 1910.
Superintendent, Gas Department, Columbia Railway, Gas & Electric Company, 2805 Wilson Street, Columbia, South Carolina.

Bruce, Howard, October, 1906.
Vice-President, The Bartlett Hayward Company, Continental Building, Baltimore, Maryland.

Bruff, Charles L., March, 1911.
Combustion Engineer, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Brundage, Henry M., September, 1908.
Assistant Secretary, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Brundrett, Ernest L., October, 1906. (P)
President, Kansas City Gas Company, 910 Grand Avenue, Kansas City, Missouri.

Brush, Daniel Harmon, Jr., March, 1912.
Detroit, Michigan.

Bryans, Henry Bussell, March, 1908.
Engineer, Counties Gas & Electric Company, Norristown, Pa.

Bryant, Charles F., October, 1906.
Auditor, Westchester Lighting Company, 1st Avenue and 1st Street, Mount Vernon, New York.

Buchanan, Paul R., September, 1915.
Superintendent, Hartford City Gas Light Company, 565 Main Street, Hartford, Connecticut.

Buckley, Martin F., March, 1913.
Foreman, Consolidated Gas Company, 501 East 21st Street, New York, New York.

Bulfin, John F., September, 1916.
Auditor, Laclede Gas Light Company, 1017 Olive Street, St. Louis, Missouri.

Bull, David M., September, 1913. (P)
Assistant Superintendent, Consolidated Gas Company, 99th Street and 2nd Avenue, New York, New York.

Bullard, John Ervin, March, 1913.
Manager, New Business Department, Public Service Corporation of Long Island, Port Washington, New York.

Bunker, Theodore, October, 1906.
Engineer, Gas Department, Public Service Gas Company, 80 Park Place, Newark, New Jersey.

Burcombe, Norman Smith, March, 1911.
Manager, Grays Harbor Gas Company, 210 South Broadway, Aberdeen, Washington.

Burgi, Herman, October, 1906.
General Superintendent, Gas Light Company, State and Water Streets, Springfield, Massachusetts.

Burke, John Edward, March, 1914.
Superintendent of Distribution, Buffalo Gas Company, 249 West Genesee Street, Buffalo, New York.

Burleigh, John J., September, 1907.
Second Vice-President, Public Service Gas Company, 418 Federal Street, Camden, New Jersey.

Burns, John J., March, 1914.
Superintendent, Commercial Department, Laclede Gas Light Company, 11th and Olive Streets, St. Louis, Missouri.

Burritt, Dwight F., September, 1907. (P)
General Superintendent, National Gas, Electric Light & Power Company, 1714 Ford Building, Detroit, Michigan.

Burt, Austin, October, 1906. (P)
Manager, Citizens Gas & Electric Company, 308 East 4th Street, Waterloo, Iowa.

Bush, Robert Wilder, October, 1906.
Engineer of Manufacture, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Butler, John Morris, September, 1913. (P)
Secretary and Treasurer, Bronx Gas & Electric Company, 43 Westchester Square, Westchester, New York.

Byrne, Edward J., October, 1906.
Engineer of Citizens Works, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Byrne, Edward Louis, September, 1910.
Superintendent, Fulton Works, The Brooklyn Union Gas Company, 265 Nevins Street, Brooklyn, New York.

Byrne, Thomas E., October, 1906.
Chief Engineer and General Manager, Kings County Lighting Company, 4802 New Utrecht Avenue, Brooklyn, New York.

Byrnes, P. V., September, 1916.
President and General Manager, United Gas & Fuel Company, 72 James Street, N., Hamilton, Ontario, Canada.

Cabell, John L., September, 1908.
Cabell & Peek, 120 Bay Street East, Savannah, Georgia.

Cabot, John, October, 1906.
1512 Grand Street, Hoboken, New Jersey.

Cadwallader, L. L., October, 1906.
Commercial Agent, Waterbury Gas Light Company, Centre and Leavenworth Streets, Waterbury, Connecticut.

Caffrey, George Henry, March, 1913.
Norwalk, Connecticut.

Cahill, William J., October, 1906.
General Manager, Gas Department, Utica Gas & Electric Company, 222 Genesee Street, Utica, New York.

Caldwell, John D., March, 1915.
Superintendent, Asheville Power & Light Company, Asheville, North Carolina.

Calhoun, Ervin, September, 1913.
Superintendent of Stores, United Gas Improvement Company, 19th Street and Allegheny Avenue, Philadelphia, Pennsylvania.

Calkins, William Bartlett, March, 1914.
Chemist, Fuel Testing Company, 220 Devonshire Street, Boston, Massachusetts.

Callenbach, Dr. J. Anton, October, 1906.
Chemical Engineer, P. O. Box 158, Dante, Virginia.

Callender, Elbert P., October, 1906.
President, *American Gas Light Journal,* Inc., 42 Pine Street, New York, New York.

Campbell, S. K., October, 1906.
Hempstead, L. I., New York.

Carbonell, Cornelius M., September, 1913.
Assistant Secretary, Astoria Light, Heat & Power Company, 130 East 15th Street, New York, New York.

Cardell, R. C., September, 1916. (P)
Manager, Billings Gas Company, Kennedy Block, Billings, Montana.

Carlson, Carl Ira, September, 1916. (P)
District Manager, Western United Gas & Electric Company, 642 North Ashland Avenue, La Grange, Illinois.

Carpenter, Harold, September, 1907. (P)
Resident Engineer, Astoria Tunnel, The Astoria Light, Heat & Power Company, 977 Whitlock Avenue, New York, New York.

Carroll, Lafayette D., September, 1908.
Mechanical Engineer, 38 Victoria Street, London, S. W., England.

CARSON, GEORGE S., October, 1906.
President, Iowa Gas & Electric Company, Washington, Iowa.

CARSON, HIRAM J., September, 1915.
General Manager, Cedar Rapids Gas Light Company, 501 East 6th Avenue, Cedar Rapids, Iowa.

CARTER, ROBERT A., September, 1907.
Vice-President, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

CARTER, ROBERT A., JR., September, 1908.
Assistant to Engineer of Manufacture, Consolidated Gas Company, 130 East 15th Street, New York, New York.

CASTOR, WILLIAM A., October, 1906. (P)
Superintendent of Meters, United Gas Improvement Company, 30 East Tulpehocken Street, Philadelphia, Pennsylvania.

CATHELS, EDMUND, October, 1906. (P)
Engineer, 28 Plain Street, Providence, Rhode Island.

CAUSEBROOK, W. R., September, 1907.
Agent, Gas and Electric Departments, Public Service Gas Company, 210 Park Avenue, Plainfield, New Jersey.

CHADWELL, WILLIAM H., September, 1907.
Superintendent, West End Gas Works, Public Service Gas Company, St. Paul and Duffield Avenues, Jersey City, New Jersey.

CHAMBERLAIN, GLENN R., October, 1906.
Secretary, Grand Rapids Gas Light Company, Pearl and Ottawa Streets, Grand Rapids, Michigan.

CHANNON, HARRY O., March, 1911. (P)
Manager, Quincy Gas, Electric & Heat Company, 422 Main Street, Quincy, Illinois.

CHAPIN, C. H. B., September, 1913. (P)
Secretary, Empire State Gas & Electric Association, 29 West 39th Street, New York, New York.

CHAPMAN, HARLEN MONROE, September, 1913.
Superintendent, Semet-Solvay Company, Indianapolis, Indiana.

CHASE, SETH KILLIAN, September, 1916.
Statistician, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

Cheeseman, Clyde Edward, March, 1915.
Superintendent's Assistant, Brooklyn Union Gas Company, 556 Kent Avenue, Brooklyn, New York.

Cheney, Herbert Neal, March, 1911.
Engineer of Construction, Boston Consolidated Gas Company, 24 West Street, Boston, Massachusetts.

Cheney, Seymour Wyatt, March, 1914. (P)
Assistant Engineer, American Public Utilities Company, Michigan Trust Building, Grand Rapids, Michigan.

Chewning, Walter L., September, 1907.
Engineering Department, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Chichester, Alfred A., October, 1906. (P)
Superintendent, North Division Street Department, Peoples Gas Light & Coke Company, 634 Hobbie Street, Chicago, Illinois.

Choate, Robert R., September, 1916.
Manager, Spokane Gas & Fuel Company, 25 Monroe Street, Spokane, Washington.

Chubb, Chester N., October, 1906. (P)
Manager, Northern Indiana Gas & Electric Company, 219 South Michigan Street, South Bend, Indiana.

Chubbuck, H. E., October, 1906.
Vice-President Executive, Illinois Traction System, Peoria, Illinois.

Clabaugh, G. W., October, 1906. (P)
Vice-President and Secretary, Omaha Gas Company, 1509 Howard Street, Omaha, Nebraska.

Clark, Horace Herbert, March, 1910.
Engineer of Gas Distribution, Public Service Company of Northern Illinois, 72 West Adams Street, Chicago, Illinois.

Clark, John A., Jr., October, 1906.
Engineer of Distribution, Public Service Gas Company, 35 Front Street, Newark, New Jersey.

Clark, John C. D., October, 1906.
Assistant Manager, Commercial and Appliance Dept., Boston Consolidated Gas Company, 24 West St., Boston, Massachusetts.

Clark, Robert Browning, March, 1911.
Superintendent of Works, Fall River Gas Works Company, 512 High Street, Fall River, Massachusetts.

Clark, Walton, October, 1906.
Second Vice-President, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Clark, William J., October, 1906.
Vice-President, Westchester Lighting Company, 1st Avenue and 1st Street, Mount Vernon, New York.

Clark, W. Van Alan, March, 1912.
With Brooklyn Union Gas Company, Foot North 12th Street, Brooklyn, New York.

Clary, Edward D., October, 1906. (P)
Superintendent, Burlington Gas Light Company, 3d and Washington Streets, Burlington, Iowa.

Clausen, William F., October, 1906. (P)
General Manager, Wisconsin-Minnesota Light & Power Company, Winona, Minnesota.

Cline, W. B., October, 1906.
President and General Manager, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

Coate, P. S., October, 1906.
Manager and Secretary-Treasurer, Chatham Gas Company, Limited, King Street, West, Chatham, Ontario, Canada.

Cobb, B. C., October, 1906.
President, Kalamazoo Gas Company; Hodenpyl, Hardy & Co., 14 Wall Street, New York, New York.

Cobb, S. P., October, 1906.
Carolina Power & Light Company, P. O. Box 785, Raleigh, North Carolina.

Cocke, J. Bowdoin, March, 1914.
Gas Engineer, Superintendent Gas Department, Rocky Mount Public Works, Rocky Mount, North Carolina.

Cohn, Chas. M., September, 1907. (P)
First Vice-President, Consolidated Gas, Electric Light & Power Company, 100 West Lexington Street, Baltimore, Maryland.

Cole, C. M., October, 1906.
Syracuse Lighting Company, Syracuse, New York.

Colf, George M., October, 1906.
Vice-President and Manager, Plattsburgh Gas & Electric Company, 30 Margaret Street, Plattsburgh, New York.

Coleman, Walter Ceely, March, 1914.
Secretary and Treasurer, Troy Gas Company, Troy, New York.

Collin, H. M., September, 1912.
General Manager, Glenns Falls Gas & Electric Light Company, 11 Warren Street, Glenns Falls, New York.

Collins, Carroll, October, 1906.
President, Treasurer and Manager, Marshall Gas Light Company, East State Street, Marshall, Michigan.

Collins, David J., October, 1906. (P)
Sales Agent, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Collins, J. Clarence, September, 1909.
Secretary, Rochester Railway & Light Company, 34 Clinton Avenue North, Rochester, New York.

Colvin, J. E., October, 1906.
Superintendent, Muncie Gas Light & Fuel Company, 301 East Main Street, Muncie, Indiana.

Combs, Roger B., October, 1906.
With United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Comstock, C. A., March, 1911.
North Few Street, Madison, Wisconsin.

Congdon, Richard C., October, 1906.
Secretary and General Manager, Atlanta Gas Light Company, Electric & Gas Building, Atlanta, Georgia.

Conlee, George D., September, 1913. (P)
Superintendent, Chuctanunda Gas Light Company, 33 Market Street, Amsterdam, New York.

Conners, Mathias, October, 1906. (P)
Superintendent, Peoples Gas Light & Coke Company, 31st Street and Pitney Court, Chicago, Illinois.

Conover, Ernest R., September, 1913.
Superintendent, Westchester Lighting Company, 7 West Main Street, Tarrytown, New York.

Cook, Chas. G., September, 1907.
Assistant Division Agent, Public Service Gas Company, 418 Federal Street, Camden, New Jersey.

Cook, Henry R., Jr., September, 1907. (P)
Assistant to General Superintendent, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Cooper, Wm. H., October, 1906.
Vice-President, Chuctanunda Gas Light Company, 96 Church Street, Amsterdam, New York.

Copley, Hon. Ira C., October, 1906.
President, Western United Gas & Electric Company, 36 Lincoln Way, Aurora, Illinois.

Cornine, Marshall, March, 1911.
Superintendent, Repair Shops, Consolidated Gas Company, 111th Street and 1st Avenue, New York, New York.

Cornish, R. C., October, 1906. (P)
Engineer, American Gas Company, 712 Locust Street, Philadelphia, Pennsylvania.

Corscot, John, October, 1906. (P)
President, Madison Gas & Electric Company, 126 East Main Street, Madison, Wisconsin.

Cortelyou, George B., March, 1912.
President, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Covert, Ira C., September, 1907.
214 Broadwater Avenue, Billings, Montana.

Cowdery, Edward G., October, 1906. (P)
President, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

Cowperthwait, B. W., October, 1906.
Manager, Consumers Power Company, Central Avenue, Faribault, Minnesota.

Cowperthwait, George E., September, 1912.
Secretary, Danbury & Bethel Gas & Electric Light Company, 238 Main Street, Danbury, Connecticut.

Crafts, Harry C., October, 1906.
Manager, Pittsfield Coal Gas Company, 30 South Street, Pittsfield, Massachusetts.

Crahan, B. J., October, 1906.
Superintendent, Joplin Gas Company, 318 Joplin Street, Joplin, Missouri.

Crane, William M., October, 1906. (P)
President, Wm. M. Crane Company, 20 West 32d Street, New York, New York.

CRAWFORD, THOMAS, March, 1907. (P)
General Manager, Clinton Gas & Electric Company, Clinton, Iowa.

CREIGHTON, JOHN THOMAS, March, 1913.
Superintendent Gas Manufacture, Los Angeles Gas & Electric Corporation, 553 Ramirez Street, Los Angeles, California.

CRESSEY, FRANK A., JR., September, 1912.
Manager, Modesto Gas Light, Coal & Coke Company, 818 Tenth Street, Modesto, California.

CRESSLER, A. D., October, 1906. (P)
President, The Kerr Murray Company, "The Brewster," 500 Diversey Parkway, Chicago, Illinois.

CRESSON, B. F., October, 1906.
President, Easton Gas & Electric Company, 2d and Ferry Streets, Easton, Pennsylvania.

CRILLY, ROGER, October, 1906.
General Foreman, Elizabethtown Gas Light Company, 19 Loomis Street, Elizabeth, New Jersey.

CRISFIELD, J. A. P., October, 1906.
Engineer, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

CROSS, CHARLES ALFRED, March, 1911. (P)
Engineer, Williamsburgh Works, Brooklyn Union Gas Company, foot of North 12th Street, Brooklyn, New York.

CROSS, FRANK L., March, 1909.
General Manager, Madison Gas & Electric Company, 1020 Sherman Avenue, Madison, Wisconsin.

CROSS, PHILIP, October, 1906.
Superintendent, New Business Dept., Fuel Appliances, Consolidated Gas Company, 130 East 15th Street, New York, New York.

CROSTON, WILLIAM F., March, 1914. (P)
Superintendent, Gas Department, Newport News & Hampton Railway, Gas & Electric Company, Newport News, Virginia.

CROWLEY, JOHN P., October, 1906. (P)
Secretary and Treasurer, St. Paul Gas Light Company, 6th and Jackson Streets, St. Paul, Minnesota.

CRUTCHER, WILLIAM H., September, 1911.
Superintendent, Gas Department, Louisville Gas & Electric Company, 201 Starks Building, Louisville, Kentucky.

Curran, G. W., October, 1906.
Secretary, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Curry, George Herbert, September, 1916.
Purchasing Agent, Laclede Gas Light Company, 11th and Olive Streets, St. Louis, Missouri.

Curtin, J. M., September, 1916.
Chief Clerk, Application Department, Laclede Gas Light Company, 1017 Olive Street, St. Louis, Missouri.

Curtis, George W., September, 1907.
Superintendent, Camden Coke Works, Gas Department, Camden, New Jersey.

Curtis, Samuel P., October, 1906. (P)
General Manager, American Gas Company, 712 Locust Street, Philadelphia, Pennsylvania.

Cutcheon, Fredk. Richard M., March, 1913.
General Manager, Consolidated Gas Company of New Jersey, 176 Broadway, Long Branch, New Jersey.

Daily, James Madison, March, 1913.
General Manager, Pueblo Gas & Fuel Company, 514 North Main Street, Pueblo, Colorado.

Dallas, Robert E., September, 1908.
Kennett Square, Pennsylvania.

Dashiell, P. T., October, 1906. (P)
Assistant Engineer of Works, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Davies, Caleb, Jr., September, 1915.
Superintendent, By-Products Coke Works, Republic Iron & Steel Company, 1811 Elm Street, Youngstown, Ohio.

Davies, Edward Livingston, September, 1912.
Gas Superintendent, Queens Boro Gas & Electric Company, 347 Central Avenue, Far Rockaway, Long Island, New York.

Davies, H. W., October, 1906.
Representative, Safety Car Heating & Lighting Company, 1738 Commercial Trust Building, Philadelphia, Pennsylvania.

Davies, James E., September, 1908. (P)
General Storekeeper, Peoples Gas Light & Coke Company, 510 West 25th Street, Chicago, Illinois.

Davis, Albert G., March, 1911.
Chemist, Consolidated Gas Company, 435 6th Avenue, Pittsburgh, Pennsylvania.

Davis, Ernest H., October, 1906.
West and Willow Streets, Williamsport, Pennsylvania.

Davis, George H., September, 1912.
Member of firm Ford, Bacon & Davis, Engineers, 921 Canal Street, New Orleans, Louisiana.

Davis, R. N., March, 1907. (P)
Testing Engineer, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

Dawes, Henry M., March, 1914.
President, Southwestern Gas & Electric Company, 111 West Monroe Street, Chicago, Illinois.

Dawes, Rufus C., October, 1906.
President, Mobile (Alabama) Gas Company, 111 West Monroe Street, Chicago, Illinois.

Dawson, George H., September, 1916. (P)
General Superintendent, Gas Department, Springfield Gas & Electric Company, 400 East Monroe Street, Springfield, Illinois.

Day, Addison Blanchard, March, 1913.
Manager of Operation, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

Day, C. L., October, 1906. (P)
General Supt., Street and Meter Dept., Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

de Castro, Joseph L., September, 1911.
Assistant Superintendent, Consolidated Gas Company, foot of East 115th Street, New York, New York.

deFreitas, William, March, 1910.
Assistant Superintendent, Appliance Department, Consolidated Gas Company, 130 East 15th Street, New York, New York.

De Frese, S. E., March, 1914. (P)
General Manager, Chattanooga Gas Company, 809 Broad Street, Chattanooga, Tennessee.

Dell, John, October, 1906. (P)
President, Missouri Fire Brick Company, 411 Olive Street, St. Louis, Missouri.

DeLong, James C., September, 1908.
President, Syracuse Lighting Company, 335 South Warren Street, Syracuse, New York.

Denman, B. J., September, 1916. (P)
Assistant General Manager, United Light & Railways Company, 125 West 3d Street, Davenport, Iowa.

Dequine, Louis Edward, September, 1914. (P)
General Superintendent, Consolidated Gas Company of New Jersey, 55 Slocum Place, Long Branch, New Jersey.

De Voe, Frederick R., March, 1913.
Secretary and Treasurer, Northern Union Gas Company, 1815 Webster Avenue, Bronx, New York, New York.

Dewey, Fred Sumner, September, 1915. (P)
General Superintendent, Muscatine Lighting Company, Muscatine, Iowa.

Dewey, V. F., October, 1906.
General Manager, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

Dexter, MacDougald, October, 1906.
Superintendent, Gas Light Company of Columbus, 1151 Broad Street, Columbus, Georgia.

Dezendorf, Richard Lee, September, 1916. (P)
Superintendent, Meter and Stove Department, New Amsterdam Gas Company, 405 East 42d Street, New York, New York.

Dickey, Charles H., October, 1906. (P)
Charles H. Dickey & Company, Guilford Avenue and Saratoga Street, Baltimore, Maryland.

Dickey, E. D. V., March, 1909. (P)
Manager, Freeport Gas Company, 156 Stephenson Street, Freeport, Illinois.

Dickey, Samuel J., March, 1908. (P)
Engineer, Gas Department, Syracuse Lighting Company, 335 South Warren Street, Syracuse, New York.

Dieterle, Edward A., March, 1908. (P)
Chemist, Glen Ellyn, Illinois.

Dillon, Harry J., September, 1911.
Superintendent, Brooklyn Borough Gas Company, Coney Island, New York.

Dixon, J. Alfred, October, 1906.
Vice-President and Manager, Pintsch Compressing Company, 2 Rector Street, New York, New York.

Dixon, R. M., October, 1906.
Vice-President, Pintsch Compressing Company, 2 Rector Street, New York, New York.

Doane, George W., September, 1910.
President, New Amsterdam Gas Company, 130 East 15th Street, New York, New York.

Dodd, George D., September, 1916.
District Superintendent, Laclede Gas Light Company, 4650 Labadie Avenue, St. Louis, Missouri.

Dodds, Caryl J., March, 1916. (P)
General Manager, Citizens Light, Heat & Power Company, 5 East 8th Street, Lawrence, Kansas.

Doherty, Henry L., October, 1906.
Chairman of Board, Denver Gas & Electric Light Company, 60 Wall Street, New York, New York.

Dole, Walter S., October, 1906.
Chief Engineer, Santa Monica Water Company, 1400 Second Street, Santa Monica, California.

Donahue, E. J., October, 1906.
Engineer, Hudson Division, Public Service Gas Company, St. Paul and St. James Avenues, Jersey City, New Jersey.

Dorner, William F., October, 1906. (P)
Supt., 25th Ward Gas Works, United Gas Improvement Company, Richmond and Tioga Streets, Philadelphia, Pennsylvania.

Dorr, William J., September, 1907.
Superintendent of Gas Distribution, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

Doty, Paul, October, 1906. (P)
Vice-President and General Manager, St. Paul Gas Light Company, Sixth and Jackson Streets, St. Paul, Minnesota.

Dougherty, Benjamin A., October, 1906.
Superintendent, Richmond Water & Light Company, Richmond, Kentucky.

Douglas, Henry W., October, 1906.
Manager, Ann Arbor Gas Company, 211 East Huron Street, Ann Arbor, Michigan.

Douglas, James B., September, 1909. (P)
Manager, Claim Department, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Douthirt, W. F., October, 1906.
Fourth Vice-President, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Dow, Fred N., March, 1914.
President, Portland Gas Light Company, Box 668, Portland, Maine.

Downey, James N., September, 1907.
Assistant Superintendent, Camden Coke Company, Camden, New Jersey.

Drake, Francis Edward, September, 1914. (P)
Manager, Gas Department, Lynn Gas & Electric Company, 90 Exchange Street, Lynn, Massachusetts.

Drum, Frank G., March, 1915.
President, Pacific Gas & Electric Company, 354 Pine Street, San Francisco, California.

Dudley, Arthur D., March, 1908.
New Business Agent, Syracuse Lighting Company, Syracuse New York.

Duggan, Frank P., March, 1911. (P)
Superintendent, Gas Department, Penn Central Light & Power Company, 31 West Market Street, Lewistown, Pennsylvania.

Dunbar, James W., October, 1906. (P)
Assistant to President, United Gas & Electric Company, 138 East Spring Street, New Albany, Indiana.

Duncan, Ronald Bruce, September, 1911. (P)
Supt., Spring Garden District, United Gas Improvement Company, 1615 North 9th Street, Philadelphia, Pennsylvania.

Dunn, F. S., October, 1906.
Superintendent, Municipal Gas Company, 1131 Broadway, Albany, New York.

Dunne, Philip, October, 1906.
Night Superintendent, Consolidated Gas Company of New York, 558 West 170th Street, New York, New York.

Dustin, Guy K., October, 1906.
48 Macon Street, Brooklyn, N. Y.

DUTTON, LEWIS R., October, 1906.
Division Manager, Jenkintown District, Philadelphia Suburban Gas & Electric Company, Jenkintown, Pennsylvania.

DUTTON, R. H., October, 1906.
Colmar, Pennsylvania.

EARNSHAW, EDWARD H., October, 1906. (P)
Assistant General Manager, Public Service Gas Company, 759 Broad Street, Newark, New Jersey.

EATON, ALFRED B., October, 1906. (P)
Vice-President, Sheboygan Gas Light Company, 1519 Peoples Gas Building, Chicago, Illinois.

EATON, CYRUS S., September, 1914.
President and Manager, Continental Gas & Electric Corporation, Cuyahoga Building, Cleveland, Ohio.

EATON, HOMER M., March, 1910.
With W. E. Moss & Company, 710 Union Trust Building, Detroit, Michigan.

EATON, JAMES B., March, 1907.
Purchasing Agent, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

EATON, W. M., October, 1906.
1834 Fourth Street, Jackson, Michigan.

EAVENSON, WILLIAM K., October, 1906.
Representative, Industrial Gas Appliance Laboratory, Consolidated Gas Company, 130 East 15th Street, New York, New York.

EDMUND, HARVEY WILLIAM, September, 1916. (P)
Commercial Agent, Western United Gas & Electric Company, Aurora, Illinois.

EINSTEIN, A. C., March, 1908.
Vice-President and General Manager, Union Electric Light & Power Company, 315 North 12th Street, St. Louis, Missouri.

ELBERT, V. L., October, 1906. (P)
General Manager, St. Joseph Gas Company, 8th and Francis Streets, St. Joseph, Missouri.

ELDER, DAVID, September, 1907.
Minnesota Steel Company, Duluth, Minnesota.

ELLIOTT, ARTHUR H., October, 1906.
Consulting Engineer-Chemist, 30 Church Street, New York, New York; 49 Whitestone Avenue, Flushing, New York.

Elliott, LaRue B., September, 1908.
Division Supt., North Division Street Dept., Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

Ellis, Harry, September, 1907. (P)
Engineer of Distribution, Public Service Gas Company, Front and Cherry Streets, Camden, New Jersey.

Ellis, John W., October, 1906.
President and Manager, Providence Gas Company, Turks Head Building, Providence, Rhode Island.

Elston, I. C., Jr., October, 1906. (P)
Elston, Clifford & Company, 707 New York Life Building, 39 South LaSalle Street, Chicago, Illinois.

Engel, Francis, October, 1906.
Secretary, Elizabethtown Gas Light Company, 124 Broad Street, Elizabeth, New Jersey.

English, A. L., October, 1906.
Manager, Citizens Gas & Electric Company, 26 Pearl Street, Council Bluffs, Iowa.

Estberg, Howard C., September, 1911. (P)
Engineer, Washington Gas & Electric Company, Washington Court House, Ohio.

Eustace, John H., October, 1906. (P)
Engineer, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

Evans, Charles D., March, 1911.
Division Superintendent, Philadelphia Company, 435 6th Avenue, Pittsburgh, Pennsylvania.

Evans, George B., October, 1906. (P)
Chief Engineer, Laclede Gas Light Company, 11th and Olive Streets, St. Louis, Missouri.

Evans, Owen Brooke, September, 1907. (P)
Superintendent, Experimental Plant, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Eves, Philmer, September, 1907.
Advertising Manager, New Haven Gas Light Company, 80 Crown Street, New Haven, Connecticut.

Eysenbach, E. E., October, 1906. (P)
Manager, Hartford City Gas Light Company, 565 Main Street, Hartford, Connecticut.

FAIR, CAMPBELL W., October, 1906.
President and Manager, Webster City Gas Company, Webster City, Iowa.

FANCHER, NATHANIEL C., March, 1910.
Superintendent of Manufacture, Seattle Lighting Company, Seattle, Washington.

FARRAR, HARRY L., September, 1916. (P)
Engineer, Southern Illinois Gas Company, Marion, Illinois.

FENNIMAN, JOHN ROFF, March, 1914.
Superintendent, Consolidated Gas Company, 1907 Amsterdam Avenue, New York, New York.

FERGUSON, B. B., October, 1906. (P)
President and Superintendent, Portsmouth Gas Company, 512 High Street, Portsmouth, Virginia.

FERRIER, JAMES, October, 1906.
317 East 4th Street, Rome, Georgia.

FERRIS, HERBERT H., October, 1906.
Engineer of Manufacture, Essex Division, Public Service Gas Company, 446 Market Street, Newark, New Jersey.

FIELD, HORACE HOPKINS, September, 1911. (P)
Engineer, Sanderson & Porter, 72 West Adams Street, Chicago, Illinois.

FIELD, ROY ALBRIGHT, October, 1906. (P)
New Business Manager, National General Electric Light & Power Company, 1714 Ford Building, Detroit, Michigan.

FIRSTBROOK, HARRY, March, 1914.
Consumers Gas Company, 234 West Broadway, Princeton, Indiana.

FISHER, DAVID G., October, 1906.
202 Bechtel Building, Davenport, Iowa.

FISHER, HOWELL, March, 1911.
The Bartlett Hayward Company, Baltimore, Maryland.

FITZ, ROBERT F., October, 1906.
Consulting Engineer, Post Office Box 275, Los Angeles, California.

FITZGERALD, LEONARD, October, 1906. (A)
Superintendent, Gas & Electric Department, Gary Heat, Light & Water Company, Broad and Fifth Avenue, Gary, Indiana.

Fleischhauer, Fredk. J., September, 1916.
Assistant Engineer, Henry I. Lea, Consulting Gas Engineer, 1352 Peoples Gas Building, Chicago, Illinois.

Flook, William M., March, 1908.
Secretary, Kings County Lighting Company, 42d Street Building, New York, New York.

Flowers, Dean Wilcox, September, 1907. (P)
General Superintendent, St. Paul Gas Light Company, 6th and Jackson Streets, St. Paul, Minnesota.

Fogg, Oscar H., October, 1906. (P)
Engineer of Utilization, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Folger, Oliver H., September, 1912.
Assistant Superintendent of Distribution, Public Service Gas Company, 40 Columbia Avenue, Passaic, New Jersey.

Folsom, Robert Morse, September, 1911.
Second Assistant Superintendent, New England Gas & Coke Company, Everett, Massachusetts.

Ford, A. H., October, 1906.
Vice-President and General Manager, York County Power Company, Portland, Maine.

Forstall, Alfred E., October, 1906. (P)
Consulting Engineer, Secretary Trustees Gas Educational Fund, 84 William Street, New York, New York.

Forstall, Walton, October, 1906.
Assistant Engineer of Distribution, The United Gas Improvement Company, Broad and Arch Sts., Philadelphia Pennsylvania.

Fowler, Samuel J., October, 1906.
Treasurer and Agent, Charlestown Gas & Electric Company, 29 Main Street, Charlestown, Massachusetts.

Fox, Clifford S., October, 1906.
Superintendent, East River Gas Company, Webster Avenue and East River, Long Island City, New York.

Francklyn, Charles G., March, 1911.
General Agent, Central Union Gas Company, 519 Cortlandt Avenue, New York, New York.

Francklyn, Gilbert, March, 1909.
Engineer of Distribution, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Frazer, D. H., October, 1906.
Treasurer and General Manager, Calhoun Gas Company, 26 East Main Street, Battle Creek, Michigan.

Freeman, Frederick Charles, September, 1910. (P)
Engineer, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Freese, Fred. W., October, 1906. (P)
Gas Works Engineer and Contractor, Fort Wayne, Indiana.

Frick, John A., October, 1906. (P)
Vice-President and General Manager, Allentown-Bethlehem Gas Company, 516 Hamilton Street, Allentown, Pennsylvania.

Frueauff, Frank W., October, 1906.
President, Denver Gas & Electric Light Company, H. L. Doherty & Company, 60 Wall Street, New York, New York.

Frueauff, Harry D., March, 1910.
General Manager, Montgomery Light & Power Company, 2100 First Avenue, Montgomery, Alabama.

Fulweiler, Walter Herbert, September, 1907. (P)
Chemist, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Furlong, William G., March, 1911.
Secretary and Treasurer, Municipal Gas Company, 112 State Street, Albany, New York.

Gadsden, P. H., March, 1911.
President, Charleston Consolidated Railway & Lighting Company, Charleston, South Carolina.

Galloway, Edward William, March, 1913. (P)
Assistant Engineer, Gas Department, Illinois Northern Utilities Company, Mendota, Illinois.

Galt, James Henry, September, 1913.
Superintendent of Works and Distribution, Public Service Gas Company, 147 East Hanover Street, Trenton, New Jersey.

Gannon, John J., October, 1906. (P)
Superintendent and Agent, Vicksburg Gas Company, 707 Crawford Street, Vicksburg, Mississippi.

Ganser, Herbert H., October, 1906. (P)
Manager, Counties Gas & Electric Company, 212 DeKalb Street, Norristown, Pennsylvania.

GANZ, ALBERT FREDERICK, September, 1913.
Consulting Engineer; Professor of Electrical Engineering, Stevens Institute of Technology, Hoboken, New Jersey.

GARRISON, RALPH HOWARD, March, 1914.
General Superintendent, Standard Gas Company, Atlantic Highlands, New Jersey.

GARRITY, EDWARD, September, 1916. (P)
District Manager, Western United Gas & Electric Company, 111 East Front Street, Wheaton, Illinois.

GARTLEY, WILLIAM H., October, 1906.
Engineer of Philadelphia Gas Works, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

GAVIT, E. PALMER, October, 1906.
90 State Street, Albany, New York.

GAWTRY, LEWIS B., September, 1908.
Vice-President, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

GEFVERT, CHARLES J., September, 1910. (P)
Engineer's Assistant, Consolidated Gas Company, 130 East 15th Street, New York, New York.

GEIST, CARLTON, March, 1912.
General Manager, Atlantic City Gas Company, 2001 Atlantic Avenue, Atlantic City, New Jersey.

GEIST, CLARENCE H., March, 1912.
President, Atlantic City Gas Company, 1127 Land Title Building, Philadelphia, Pennsylvania.

GENAY, THOMAS BERTRAM, October, 1906.
Manager, Northern Indiana Gas & Electric Company, 64 North Broadway, Peru, Indiana.

GENAY, THOMAS S., October, 1906.
Chief Clerk to Second Vice-President, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

GERDENIER, C. M., March, 1909.
Superintendent, Bridgeport Gas Light Company, 174 Arch Street, Bridgeport, Connecticut.

GEROULD, CHARLES L., October, 1906.
Vernon Stiles Inn, Thompson, Connecticut.

GIFFORD, N. W., October, 1906. (P)
General Manager, East Boston Gas Company, 38 Central Square, East Boston, Massachusetts.

GILCHRIST, JOHN FOSTER, September, 1914.
President, Missouri Gas & Electric Service Company, 72 West Adams Street, Chicago, Illinois.

GILL, JOHN E., September, 1914.
President, The Manufacturers Light & Heat Company, 248 Fourth Avenue, Pittsburgh, Pennsylvania.

GILLETT, MELVILLE, October, 1906.
Director, Gas Companies, Smethport, Pennsylvania.

GILPIN, FRANCIS HOPKINSON, September, 1907. (P)
Gas Engineer, The United Gas Improvement Company, 3101 Passyunk Avenue, Philadelphia, Pennsylvania.

GINLEY, JOHN, September, 1908.
Assistant General Supt., Street and Meter Dept., Peoples Gas Light & Coke Co., 122 South Michigan Ave., Chicago, Illinois.

GLASGOW, ARTHUR GRAHAM, October, 1906.
Humphreys & Glasgow, 36 Victoria Street, London, S. W., England.

GLASS, SHELDON J., October, 1906. (P)
Vice-President, Milwaukee Gas Light Company, 182 Wisconsin Street, Milwaukee, Wisconsin.

GOFF, IRA NATHAN, JR., March, 1915.
Superintendent, Gas Works for the United States Government, West Point, New York.

GOLDEN, JOHN W., October, 1906. (P)
Vice-President, Savannah Gas Company, 110 Broughton Street, West, Savannah, Georgia.

GOODNOW, ALBERT C., September, 1916. (P)
General Manager, North Shore Gas Company, Waukegan, Illinois.

GOODNOW, GEORGE F., October, 1906. (P)
Vice-President, North Shore Gas Company, 213 North Genesee Street, Waukegan, Illinois.

GORDON, LEROY O., March, 1913. (P)
Manager, Valparaiso Lighting Company, 152 West Main Street, Valparaiso, Indiana.

GOUDY, ROY ALONZO, March, 1914.
Manager, Petersburg Gas Company, 230 South Sycamore Street, Petersburg, Virginia.

GOUDY, W. R., October, 1906.
With Williamson & Mead, 30 East 42d Street, New York, New York.

GOULD, JOHN A., October, 1906. (P)
Engineer of Distribution, Boston Consolidated Gas Company, 24 West Street, Boston, Massachusetts.

GRAEFF, HAROLD W., October, 1906.
1513 North Thirty-third Street, Philadelphia, Pennsylvania.

GRAF, CARL H., October, 1906.
Vice-President and General Manager, Municipal Gas Company, 112 State Street, Albany, New York.

GRAHAM, ALLAN S., September, 1908. (P)
Superintendent, Sioux Falls Gas Company, Sioux Falls, South Dakota.

GRAHAM, MALCOLM M., October, 1906.
Secretary and Treasurer, New Amsterdam Gas Company, 130 East 15th Street, New York, New York.

GRANT, ROBERT, September, 1907.
Treasurer, Boston Consolidated Gas Company, 24 West Street, Boston, Massachusetts.

GRAVELEY, RICHARD C., September, 1914.
Manager, Long Island Gas Corporation, Sag Harbor, Long Island, New York.

GRAY, CARROLL E., JR., September, 1916.
Manager, Boise Gas Light & Coke Company, Boise, Idaho.

GREENE, RAYMOND LEWIS, March, 1913.
Assistant Superintendent, Brooklyn Union Gas Company, 556 Kent Avenue, Brooklyn, New York.

GRESHAM, LEONARD G., September, 1915.
Superintendent of Lighting and Power, Lynchburg Traction & Light Company, 523 Main Street, Lynchburg, Virginia.

GREY, JOHN CHESTER, September, 1908. (P)
Superintendent, Savannah Gas Company, 110 Broughton Street, West, Savannah, Georgia.

GRIBBEL, JOHN, October, 1906.
President, Tampa (Florida) Gas Company, 1513 Race Street, Philadelphia, Pennsylvania.

GRISWOLD, R. G., October, 1906. (P)
Gas Engineer, with H. L. Doherty & Company, 60 Wall Street, New York, New York.

GROVER, SHERWOOD, March, 1915.
Assistant Gas Engineer, Pacific Gas & Electric Company, Grant Building, 7th and Market Streets, San Francisco, California.

GRUBER, CHARLES A., September, 1912.
Manager, Saranac Lake Gas Company, 20 Main Street, Saranac Lake, New York.

GUFFEY, JOSEPH F., October, 1906.
General Manager, The Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

GULDLIN, OLAF N., October, 1906. (P)
President, Western Gas Construction Company, 2306 Fairfield Avenue, Fort Wayne, Indiana.

GUNN, ARTHUR, March, 1914.
President, Wenatchee Valley Gas & Electric Company, Wenatchee, Washington.

HAAG, F. E., March, 1909.
Auditor, Williamsport (Pa.) Gas Company, H. D. Walbridge & Company, 14 Wall Street, New York, New York.

HAASE, EWALD, October, 1906. (P)
Secretary and Treasurer, Milwaukee Gas Light Company, 182 Wisconsin Street, Milwaukee, Wisconsin.

HACKSTAFF, JOHN DUDLEY, September, 1913.
Consulting Engineer, 1516 Second Avenue, Los Angeles, California.

HADDOCK, ISAAC T., September, 1913.
Chemist for Cambridge Gas Light Company, 354 Third Street, East Cambridge, Massachusetts.

HAFTENKAMP, JOSEPH P., September, 1907.
Assistant Superintendent, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

HAIGHT, THEODORE, March, 1911.
President, Plant Engineering & Equipment Company, Inc., 6 Church Street, New York, New York.

HAINES, JANSEN, October, 1906. (P)
Manager, Des Moines Gas Company, 412 West 7th Street, Des Moines, Iowa.

HALL, A. H., October, 1906.
Assistant Secretary and Superintendent of Distribution, Central Union Gas Company, 519 Cortlandt Ave., New York, New York.

HALL, ELMON LAWRENCE, September, 1912.
Chief Engineer, Portland Gas & Coke Company, 292 Yamhill Street, Portland, Oregon.

HALSEY, WILLIAM M., March, 1909.
Agent, Public Service Gas Company, Gas and Electric Departments, 759 Broad Street, Newark, New Jersey.

HAMMATT, CLARENCE S., October, 1906.
Consulting Engineer, 1943 Main Street, Jacksonville, Florida.

HAMMOND, WILBER M. R., March, 1912.
Comptroller, New York & Richmond Gas Company, 691 Bay Street, Stapleton, Staten Island, New York.

HANLAN, J. P., September, 1907.
New Business Assistant, Public Service Gas Company, Post Office Box 590, Newark, New Jersey.

HANTZMON, H. M., October, 1906.
Superintendent, City Gas Department, Charlotteville, Virginia.

HARDICK, CHARLES F., October, 1906.
District Superintendent and Agent, The United Gas Improvement Company, 5961 Ridge Avenue, Philadelphia, Pennsylvania.

HARE, C. WILLING, September, 1908.
Manager, New Business Department, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

HARE, JOSEPH B., March, 1913.
Assistant Superintendent, Mains and Services, Central Union Gas Company, 519 Cortlandt Avenue, New York, New York.

HARGREAVES, ROBERT H., September, 1912.
Superintendent, Gas Works, Pacific Gas & Electric Company, 48 East San Antonio Street, San Jose, California.

HARLOW, JUSTIN EDWARDS, March, 1913. (P)
Construction Engineer, Illinois Northern Utilities Company, 310 Peoria Avenue, Dixon, Illinois.

HARPER, ROBERT BRINTON, March, 1908. (P)
Superintendent of Testing Laboratories, Peoples Gas Light and Coke Company, 2501 Salt Street, Chicago, Illinois.

HARRIES, GEORGE HERBERT, September, 1912. (P)
President, Louisville Gas & Electric Company, 311 West Chestnut Street, Louisville, Kentucky.

HARRIMAN, HORACE MARSHALL, March, 1908.
General Superintendent, New Orleans Gas Light Company, 201 Baronne Street, New Orleans, Louisiana.

HARRINGTON, WALTER K., September, 1908. (P)
Manager, The American Meter Company, 11th Avenue and 47th Street, New York, New York.

HARRIS, ALAN HALE, JR., September, 1914. (P)
Superintendent, Coal Products Manufacturing Company, Joliet, Illinois.

HARSH, J. E., September, 1916.
Chief Engineer, Hale Gas Company, Neodesha, Kansas.

HART, JULIAN G., September, 1912. (P)
Engineer, Gas Production, Public Service Company of Northern Illinois, 72 West Adams Street, Chicago, Illinois.

HARTMAN, WILLIAM E., October, 1906.
Consulting Engineer, By-Products Coke Ovens, 327 South La Salle Street, Chicago, Illinois.

HATHAWAY, E. C., October, 1906.
Assistant General Manager, Virginia Railway & Power Company, Norfolk, Virginia.

HAUG, JOHN SOBIESKI, September, 1914.
2313 Durant Avenue, Berkeley, California.

HAWTHORNE, WILLIAM JAMES, September, 1908.
Superintendent, Water Gas Plant, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

HAYES, CLIFTON R., September, 1912.
Manager, Fitchburg Gas & Electric Light Company, 256 Main Street, Fitchburg, Massachusetts.

HAYS, VICTOR ALDEN, March, 1916.
President and Auditor for Receivers, Kansas Natural Gas Company, Post Office Box 465, Independence, Kansas.

Heckert, Oscar Harbaugh, March, 1916. (P)
Secretary and General Manager, York Gas Company, York, Pennsylvania.

Hedges, William C., October, 1906.
Secretary and Treasurer, Mansfield Gas Light Company, 8 South Park Street, Mansfield, Ohio.

Hellen, Frank, March, 1907. (P)
Superintendent, Gas Distribution Dept., Rochester Railway & Light Company, 34 Clinton Ave., North, Rochester, New York.

Hellen, John, October, 1906. (P)
Superintendent of Distribution, Grand Rapids Gas Light Company, 109 North Ottawa Street, Grand Rapids, Michigan.

Helme, William E., October, 1906.
Director several Gas Companies, 1339 Cherry Street, Philadelphia, Pennsylvania.

Helps, George, September, 1913.
Civil Engineer, Engineer and Manager, Nuneaton Gas Company, Nuneaton, England.

Hemminger, George Reverdey, September, 1908.
Engineer with The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Henderson, Curtis L., September, 1916.
International Hale Gas Mixer Company, Providence, Rhode Island.

Henderson, Samuel W., September, 1912.
Vice-President and General Manager, Water, Gas & Electric Company, Excelsior Springs, Missouri.

Henderson, William M., September, 1912.
Assistant Gas Engineer, Pacific Gas & Electric Company, 445 Sutter Street, San Francisco, California.

Hendrickson, George S., March, 1914.
Superintendent's Assistant, Brooklyn Union Gas Company, 12th Street and Gowanus Canal, Brooklyn, New York.

Henofer, J. P., March, 1909.
Superintendent, Holder Stations, Public Service Gas Company, St. Paul and St. James Avenues, Jersey City, New Jersey.

Hering, Edward, March, 1913.
Assistant to Chief Engineer, United States Cast Iron Pipe & Foundry Company, Burlington, New Jersey.

Hewitt, Arthur, September, 1910.
General Manager, Consumers Gas Company, 19 Toronto Street, Toronto, Ontario, Canada.

Hillemeyer, Joseph E., March, 1910. (P)
Engineer, St. Louis County Gas Company, Lockwood and McClure Avenues, Webster Groves, Missouri.

Himsworth, Hines Horace, March, 1914.
Superintendent's Assistant, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

Hine, Willard Foster, September, 1911. (P)
Chief Gas Engineer, Public Service Commission for the First District, 120 Broadway, New York, New York.

Hinman, Charles W., October, 1906.
Chemical Engineer, 10 Fenwick Road, Winchester, Massachusetts.

Hintze, Thomas Henry, March, 1914.
Superintendent, Sassafras Point Station, Providence Gas Company, Providence, Rhode Island.

Hirst, Homer T., September, 1910.
Assistant Superintendent, North Division, Peoples Gas Light & Coke Company, 634 Hobbie Street, Chicago, Illinois.

Hirst, Jesse Bowman, September, 1910. (P)
Assistant to Engineer, Peoples Gas Light & Coke Company, Peoples Gas Building, Chicago, Illinois.

Hockenbeamer, A. F., September, 1915.
Vice-President and Treasurer, Pacific Gas & Electric Company, 445 Sutter Street, San Francisco, California.

Hodges, C. H., March, 1909.
Assistant Superintendent, Consolidated Gas Company of New York, 501 East 21st Street, New York, New York.

Hodgson, Harry Ellsworth, September, 1916.
Assistant to Superintendent, The United Gas Improvement Company, Point Breeze Gas Works, Philadelphia, Pennsylvania.

Hoffman, Howard, October, 1906. (P)
Superintendent, Gas Department, Counties Gas & Electric Company, Ardmore, Pennsylvania.

Holden, Thomas F., October, 1906.
Superintendent of Works, Georgetown Gas Light Company, 218 Eighth Street, S. W., Washington, District of Columbia.

Holman, C. L., October, 1906. (P)
President and General Manager, The Laclede Gas Light Company, 11th and Olive Streets, St. Louis, Missouri.

Holzer, Edwin G., October, 1906. (P)
Superintendent, Easton Gas & Electric Company, 349 Bushkill Street, Easton, Pennsylvania.

Hone, Frederic deP., September, 1911.
Consulting Engineer, 1 Liberty Street, New York, New York.

Hopper, Thomas B., September, 1916.
Superintendent, West Station, Washington Gas Light Company, 413 Tenth Street, N. W., Washington, District of Columbia.

Horning, George R., September, 1908.
Manager, Macon Gas Company, 220 Second Street, Macon, Georgia.

Hough, David Leavitt, October, 1906.
President, United Engineering & Contracting Company, 17 West 42d Street, New York, New York.

Houghton, Charles P., September, 1910.
Second Vice-President, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

Howard, Abram C., October, 1906.
Gas Engineer, United Gas & Electric Engineering Corporation, 61 Broadway, New York, New York.

Howard, Charles A., September, 1906.
President, Aberdeen Gas Company, Aberdeen, South Dakota.

Howland, Lewis A., March, 1910.
General Superintendent, Queens Borough Gas & Electric Company, 345 Central Ave., Far Rockaway, New York.

Hoy, Chas. W., March, 1908.
Manager, New Jersey Gas Company, Glassboro, New Jersey.

Hoyt, Harry B., October, 1906.
General Manager, Jacksonville Gas Company, Church and Laura Streets, Jacksonville, Florida.

Hoyt, William G., October, 1906.
President, The Standard Gas Light Company, 130 East 15th Street, New York, New York.

Huber, Frank, October, 1906. (P)
Assistant Superintendent, Distribution Dept., Louisville Gas & Electric Company, 1006 Cherokee Road, Louisville, Kentucky.

Huddle, Wiley Jerome, March, 1913. (P)
Sloan, Huddle, Feustel & Freeman, Consulting Engineers, Washington Building, Madison, Wisconsin.

Hudson, Darwin S., March, 1909.
Supervising Field Engineer, Construction Department, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Huestis, Leon David, March, 1909.
Superintendent of Manufacture, Philadelphia Suburban Gas & Electric Company, 912 Highland Avenue, Chester, Pennsylvania.

Hulswit, Frank T., October, 1906.
President, United Light & Railway Company, 411 Michigan Trust Building, Grand Rapids, Michigan.

Hulswit, John A., March, 1912.
Treasurer, Grand Rapids Gas Light Company, Pearl and Ottawa Streets, Grand Rapids, Michigan.

Humphreys, Alexander C., October, 1906.
President, Buffalo (N. Y.) Gas Company, and President, Humphreys & Miller, 165 Broadway, New York, New York.

Humphreys, C. J. R., October, 1906.
Vice-President and Agent, Lawrence Gas Company, 370 Essex Street, Lawrence, Massachusetts.

Humphreys, Frank Wilder, March, 1911.
George M. Clark & Company Division, American Stove Company, 209 West 43d Street, New York, New York.

Humphreys, J. J., October, 1906.
Gas Engineer, McKinnon Dash Company, St. Catharines, Ontario, Canada.

Humphrys, Henry M., October, 1906. (P)
Superintendent, West Side Works, Milwaukee Gas Light Company, 182 Wisconsin Street, Milwaukee, Wisconsin.

Hunt, H. R., October, 1906.
Division Superintendent, Peoples Gas Light & Coke Company, 25th and Loomis Streets, Chicago, Illinois.

Hunter, Chas. W., September, 1909.
Gas Engineer, with Stone & Webster Engineering Corporation, 147 Milk Street, Boston, Massachusetts.

Hunter, James F., March, 1909.
Assistant Engineer of Construction, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Hurlburt, Alfred, October, 1906.
Engineer, Kansas City Gas Company, 910 Grand Avenue, Kansas City, Missouri.

Hutchings, James T., September, 1907.
General Manager, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

Hutchinson, Frank R., October, 1906.
Sales Manager, The Gas Appliance Company, 713 Frankfort Avenue, West, Cleveland, Ohio.

Hyde, Edward Bolton, September, 1911.
Superintendent, Commercial Department, New Amsterdam Gas Company, 130 East 15th Street, New York, New York.

Ikena, Frederick J., September, 1912.
Superintendent of Works, Municipal Gas Company, 1131 Broadway, Albany, New York.

Ives, Herbert E., March, 1913.
Physicist, The United Gas Improvement Company, 3101 Passyunk Avenue, Philadelphia, Pennsylvania.

Jack, Wallace A., March, 1914.
Assistant Construction Engineer, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Jackson, Alfred H. R., March, 1915.
General Superintendent, Oskaloosa Light & Fuel Company, 202 High Avenue, West, Oskaloosa, Iowa.

Jackson, Dugald C., March, 1914.
Senior Member of Firm of D. C. & Wm. B. Jackson, 248 Boylston Street, Boston, Massachusetts.

Jackson, Thomas H., March, 1910.
General Agent, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Jackson, William B., October, 1906.
Consulting Engineer, 111 West Monroe Street, Chicago, Illinois.

Jacobson, Ernest, September, 1910.
Care of David G. Fisher & Company, 202 Bechtel Building, Davenport, Iowa.

James, F. M., October, 1906. (P)
General Accountant, Western United Gas & Electric Company, 396 Downer Place, Aurora, Illinois.

James, Robert C., September, 1907. (P)
General Auditor, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Jardine, David William, September, 1913.
Assistant Manager, Burlington Light & Power Company, Burlington, Vermont.

Jayne, Ralph A., March, 1913.
Superintendent of Distribution, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

Jefferis, Charles A., September, 1916.
General Superintendent, Consumers Gas Company, 269 Front Street, East, Toronto, Ontario, Canada.

Jelliffe, C. N., October, 1906.
Second Vice-President, American Light & Traction Company, 120 Broadway, New York, New York.

Jennings, Robt. J., October, 1906. (P)
Superintendent, Pelham Works, Westchester Lighting Company, 1st Avenue and 1st Street, Mt. Vernon, New York.

Jochum, Henry Lux, March, 1914. (P)
Field Engineer in Charge, Astoria Construction, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

Johnson, Adolph C., September, 1913.
Assistant Superintendent, Consolidated Gas Company, 112 West 42d Street, New York, New York.

Johnson, Guy Maxwell, September, 1912.
Engineer, Omaha Gas Company, 1509 Howard Street, Omaha, Nebraska.

Johnson, Herbert Gilmore, October, 1906.
Superintendent of Manufacture, Utica Gas & Electric Company, 222 Genesee Street, Utica, New York.

Johnson, Ole Seaholm, September, 1913.
Main Foreman, St. Paul Gas Light & Coke Company, 6th and Jackson Streets, St. Paul, Minnesota.

Johnston, Mervyn E., October, 1906.
Assistant Secretary and Assistant Treasurer, Ogden Gas Company, 30 East 42d Street, New York, New York.

Jones, Arthur Owen, September, 1912.
Engineer, 4 Gertrude Street, Chelsea, London, S. W. England.

Jones, Edward C., October, 1906. (P)
Chief Engineer, Gas Department, Pacific Gas & Electric Company, 445 Sutter Street, San Francisco, California.

Jones, Edward Stratton, September, 1914.
Superintendent Gas Works, Pacific Gas & Electric Company, Sacramento, California.

Jones, Edwin Dubose, March, 1913.
General Foreman, Assistant to Superintendent, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Jones, Edwin Peirce, September, 1912.
Superintendent, with The United Gas Improvement Company, 6410 North Camac Street, Philadelphia, Pennsylvania.

Jones, Henry Harrison, September, 1912.
Vice-President and Manager, San Diego Consolidated Gas & Electric Company, San Diego, California.

Jones, Jacob B., March, 1915.
Superintendent, Bridgeton Gas Light Company, 26 Water Street, Bridgeton, New Jersey.

Jones, Thomas Clive, October, 1906.
President, Delaware Gas Company, 68 North Sandusky Street, Delaware, Ohio.

Jones, Thomas J., March, 1907.
With The Columbus Gas & Fuel Company, 135 North Front Street, Columbus, Ohio.

Jourdan, Edward R., October, 1906.
340 Clinton Avenue, Brooklyn, New York.

Jourdan, James H., October, 1906.
President and Chief Engineer, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Kaltwasser, Charles M., March, 1913.
General Manager, Harrisburg Light & Power Company, Harrisburg, Pennsylvania.

Kane, Joseph P., March, 1907.
Superintendent, Westchester Lighting Company, 130 North Main Street, Port Chester, New York.

Keal, George I., September, 1911.
Superintendent of Construction, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

KEEGAN, CHAS. F., September, 1908.
Superintendent, 21st Street Station, Consolidated Gas Company of New York, 501 East 21st Street, New York, New York.

KEENE, ALFRED M., October, 1906.
Comptroller, Westchester Lighting Company, 1st Avenue and 1st Street, Mount Vernon, New York.

KELLER, C. M., October, 1906.
President, Columbus Gas Light Company, 312 Washington Street, Columbus, Indiana.

KELLEY, WILLIAM D., September, 1912. (P)
General Superintendent of Meters, Consolidated Gas Company, 130 East 15th Street, New York, New York.

KELLOGG, LEONARD L., October, 1906. (P)
President, Sioux City Gas & Electric Company, 509 Pierce Street, Sioux City, Iowa.

KELLOGG, RAYMOND C., March, 1909.
Assistant to Superintendent of Street Department, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

KELLOGG, R. M., October, 1906.
Assistant Engineer, Westchester Lighting Company, Mount Vernon, New York.

KELSEY, CHARLES B., September, 1912.
Chairman, American Public Utilities Company, Grand Rapids Savings Building, Grand Rapids, Michigan.

KENDALL, ALBERT WHITTEMORE, March, 1910.
Assistant Manager, Rockford Gas Light & Coke Company, 201 Mulberry Street, Rockford, Illinois.

KENNEDY, JAMES S., October, 1906. (P)
Superintendent, Standard Gas Light Company, foot of East 115th Street, New York, New York.

KENNEDY, JOHN PENDLETON, September, 1907. (P)
General Superintendent, Cambridge Gas Light Company, 354 Third Street, East Cambridge, Massachusetts.

KEPPELMAN, JOHN H., October, 1906.
President and Superintendent, Consumers Gas Company, 20 North Fifth Street, Reading, Pennsylvania.

KEPPELMANN, D. ELLWOOD, October, 1906.
General Superintendent of Gas Distribution, Pacific Gas & Electric Company, 445 Sutter Street, San Francisco, California.

Kersting, Albert F., October, 1906.
Engineer, Mobile Gas Company, Box 234, Mobile, Alabama.

Killgore, James N., March, 1913. (P)
Engineer, Bergen Division, Public Service Gas Company, Hackensack, New Jersey.

Kister, Hannie J., September, 1916.
Manager New Business, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

Klein, August Clarence, September, 1912. (P)
Engineer, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Klumpp, John Bartleman, October, 1906.
Inspecting Engineer, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Knabe, Albert, September, 1916.
Superintendent in Distribution Department, Laclede Gas Light Company, 1017 Olive Street, St. Louis, Missouri.

Knapp, Amos M., October, 1906.
Foreman of Meter Shop, Westchester Lighting Company, 335 Warburton Avenue, Yonkers, New York.

Knapp, Isaac N., October, 1906.
116 Ardmore Avenue, Ardmore, Pennsylvania.

Knapp, William Jared, March, 1910.
Vice-President, Michigan Northern Power Company, 42d Street Building, New York, New York.

Knight, J. J., October, 1906.
Vice-President, Kalamazoo Gas Company, 123 West Street, Kalamazoo, Michigan.

Knowles, William P., October, 1906. (P)
Superintendent, Richmond City Gas Works, 2606 Grove Avenue, Richmond, Virginia.

Koiner, C. W., October, 1906.
General Manager and Engineer, Municipal Lighting Plant, Pasadena, California.

Kowalke, Otto L., September, 1909. (P)
Associate Professor Chemical Engineering, Engineering Building, University of Wisconsin, Madison, Wisconsin.

Kraft, R. P., October, 1906.
Assistant Engineer, Milwaukee Gas Light Company, 182 Wisconsin Street, Milwaukee, Wisconsin.

KRUMREY, ROBERT GARFIELD, September, 1913.
General Superintendent, Beloit Water, Gas & Electric Company, 429 East Grand Avenue, Beloit, Wisconsin.

KUBO, SHOSUKE, September, 1911.
Managing Director of Kobe Gas Company, Ltd., Kobe, Japan.

KUNZE, WALTER WILLIAM, March, 1914.
Engineer's Assistant, Brooklyn Union Gas Company, 556 Kent Avenue, Brooklyn, New York.

KUSTER, JOHN D., September, 1912.
Manager San Jose District, Pacific Gas & Electric Company, 2nd and Antonio Streets, San Jose, California.

LAMBERT, EDW. L., September, 1909.
76 Endicott Arcade, St. Paul, Minnesota.

LAMSON, WILLIAM O., JR., March, 1907. (P)
Manager, Chester County Gas Company, 33 West Gay Street, West Chester, Pennsylvania.

LANE, FREDERICK K., October, 1906.
Manager and Treasurer, Seattle Lighting Company, Seattle, Washington.

LANE, JAS. M., September, 1909.
Superintendent of Works, Public Service Gas Company, Paterson, New Jersey.

LANE, WILLIAM P., March, 1908.
Superintendent, Point Breeze Works, United Gas Improvement Company, 3101 Passyunk Avenue, Philadelphia, Pennsylvania.

LANGE, GEORGE, March, 1915.
Acting Auditor, New Amsterdam Gas Company, 130 East 15th Street, New York, New York.

LARAWAY, B. R., September, 1908.
Treasurer and General Manager, Jackson Gas Company, Jackson, Michigan.

LATHROP, ALANSON P., October, 1906. (P)
President, American Light & Traction Company, 120 Broadway, New York, New York.

LAVELLE, WILLIAM J., March, 1913. (P)
Manager Coke Sales Department, New England Coal & Coke Company, 111 Devonshire Street, Boston, Massachusetts.

LAWLOR, JAS. W., September, 1908. (P)
Superintendent North Station, Peoples Gas Light & Coke Company, 1122 Crosby Street, Chicago, Illinois.

LAWLOR, R. H., October, 1906. (P)
Assistant Engineer, Dayton Gas Company, First and St. Clair Streets, Dayton, Ohio.

LAWRENCE, JAMES, March, 1915.
Auditor, American Light & Traction Company, 120 Broadway, New York, New York.

LAWRENCE, W. F., October, 1906.
Superintendent of Manufacture, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

LEA, HENRY I., October, 1906. (P)
Consulting Gas Engineer, Peoples Gas Building, Chicago, Illinois.

LEACH, F. A., JR., September, 1912.
Oakland District Manager, Pacific Gas & Electric Company, Post Office Box 426, Oakland, California.

LEARNED, CHARLES A., October, 1906.
General Manager, Meriden Gas Light Company, 33 Colony Street, Meriden, Connecticut.

LEARNED, JOHN G., September, 1916.
Assistant to Vice-President, Public Service Company of Northern Illinois, 72 West Adams Street, Chicago, Illinois.

LEARNED, WALDO A., October, 1906. (P)
General Superintendent, Newton and Watertown Gas Light Company, 308 Washington Street, Newton, Massachusetts.

LEASK, JOHN POLLOCK, September, 1915. (P)
Superintendent's Assistant, Brooklyn Union Gas Company, Nevins and DeGraw Streets, Brooklyn, New York.

LELAND, EDW. D., September, 1909.
Superintendent of Compressing Stations, Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

LEONARD, CHARLES F., October, 1906.
Chief Gas Engineer, Public Service Commission, Second District, Albany, New York.

LETANG, B. E., October, 1906.
Proprietor, Jackson Gas Light Company, Jackson, California.

LEWIS, RAYMOND CHAPIN, March, 1911.
349 Lenox Road, Brooklyn, New York.

LEWIS, WILLIAM E., September, 1916.
Vice-President, Utica Gas & Electric Company, 222 Genesee Street, Utica, New York.

LIGHT, EDWARD H., October, 1906.
Superintendent of Distribution, Dayton Gas Light & Coke Company, 203 East First Street, Dayton, Ohio.

LIGHT, GEORGE, October, 1906.
Superintendent, Dayton Gas Light & Coke Company, 203 East First Street, Dayton, Ohio.

LILLIE, LEWIS, October, 1906.
Third Vice-President, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

LINDSAY, ROBERT, October, 1906.
Superintendent Gas Department, New Bedford Gas & Edison Light Co., 214 South Water Street, New Bedford, Massachusetts.

LINTON, SAMUEL E., JR., October, 1906.
General Manager, Nashville Gas Heating Company, 611 Church Street, Nashville, Tenn.

LITTLE, ARTHUR DEHON, March, 1908.
President, Arthur D. Little, Inc., 93 Broad Street, Boston, Massachusetts.

LITTLE, A. S. B., September, 1914. (P)
Gas Engineer to State Commission, State Public Utilities Commission, Odd Fellows Building, Springfield, Illinois.

LIVINGSTON, HERMAN, March, 1909.
Aetna Chemical Company, 1906 First National Bank Building, Pittsburgh, Pennsylvania.

LIVINGSTON, ROBERT E., September, 1911.
Advertising Manager, Consolidated Gas Company, 1 Madison Avenue, New York, New York.

LOHMEYER, HARRY BERNHARD, September, 1916. (P)
Chief Efficiency Dept., Consolidated Gas, Electric Light & Power Company, Lexington and Liberty Streets, Baltimore, Maryland.

LONG, DAVID SAMUEL, March, 1913.
Superintendent, Consumers' Gas & Coke Company, Waycross, Georgia.

LOVE, EDWARD GURLEY, March, 1913.
Chief Chemist, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Lucas, Thomas J., September, 1911. (P)
Consulting Engineer, Assistant to W. A. Baehr, 2013 Peoples Gas Building, Chicago, Illinois.

Lucena, Joseph, October, 1906.
Superintendent of Distribution, Omaha Gas Company, 1202 Howard Street, Omaha, Nebraska.

Lucke, Charles Edward, September, 1913.
Professor, Department of Mechanical Engineering, Columbia University, Morningside Heights, New York, New York.

Luckenbach, Charles A., September, 1911.
Manager of Construction, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

Luick, Adolph James, September, 1913. (P)
Assistant Consulting Engineer with W. A. Baehr, 2009 Peoples Gas Building, Chicago, Illinois.

Lundblad, Oscar J. A., March, 1911. (P)
Superintendent, Nassau & Suffolk Lighting Company, Washington Avenue, Hempstead, New York.

Lundgaard, I., March, 1913. (P)
Industrial Engineer, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

Luqueer, Robert Orr, October, 1906.
Secretary, Humphreys & Miller, Inc., 165 Broadway, New York, New York.

Luther, Frank E., October, 1906. (P)
Assistant Engineer, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

Luther, William J., October, 1906.
Superintendent, Attleboro Gas Light Company, 19 Dunham Street, Attleboro, Massachusetts.

Lydecker, Fredk. Ackerman, March, 1913.
Superintendent of Distribution, Public Service Gas Company, 35 Front Street, Newark, New Jersey.

Lynch, Eugene P., September, 1916. (P)
Chief Clerk, Clearing House Division, Accounting Dept., Laclede Gas Light Company, 1017 Olive Street, St. Louis, Missouri.

Lynn, James T., October, 1906. (P)
President, National Gas, Electric Light & Power Company, Ford Building, Detroit, Michigan.

Lyon, Chas. Lumsden, October, 1906. (P)
Superintendent, St. Augustine Gas & Electric Light Company, St. Augustine, Florida.

Lyons, B. F., October, 1906. (P)
Vice-President and General Manager, Beloit Water, Gas & Electric Company, 429 East Grand Avenue, Beloit, Wisconsin.

McArthur, John A., September, 1916.
Secretary and Treasurer, Hartford City Gas Light Company, 565 Main Street, Hartford, Connecticut.

McCallum, J. N., October, 1906.
Vice-President, Lenawee County Gas & Electric Company, Adrian, Michigan; 39 South La Salle Street, Chicago, Illinois.

McCarter, Thos. N., September, 1907.
President, Public Service Gas Company, 80 Park Place, Newark, New Jersey.

McCleary, William, September, 1916. (P)
Superintendent, New York & Richmond Gas Company, 1314 New York Avenue, Rosebank, Staten Island, New York.

McClellan, William, September, 1913. (P)
Consulting Gas Engineer, Paine, McClellan & Campion, 25 Church Street, New York, New York.

McClellon, J. M., March, 1911.
Superintendent, New England Gas & Coke Company, Everett, Massachusetts.

McCloy, Walter L., September, 1909.
General Superintendent, Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

McCorkindale, William J., October, 1906.
General Manager, Wilmington Gas Company, Wilmington, Delaware.

McCrea, Thomas P., March, 1913.
Secretary, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

McDonald, Donald, October, 1906. (P)
Vice-President and General Manager, Louisville Gas & Electric Company, 311 West Chestnut Street, Louisville, Kentucky.

McDonald, Donald, October, 1906. (P)
With D. McDonald & Company, 991 Broadway, Albany, New York.

McDonald, William, October, 1906.
With D. McDonald & Company, 991 Broadway, Albany, New York.

McDonnell, Charles E., September, 1914. (P)
Superintendent Gas Works, Quincy Gas, Electric & Heat Company, 422 Maine Street, Quincy, Illinois.

McDowell, J. C., March, 1907.
General Manager, Kansas Natural Gas Company, Farmers' Bank Building, Pittsburgh, Pennsylvania.

McGowan, Henry Eddy, March, 1911.
General Manager, The Flatbush Gas Company, 176 Remsen Street, Brooklyn, New York.

McGraw, Isaac, March, 1914.
Superintendent, New York Mutual Gas Light Company, 825 East 11th Street, New York, New York.

McGregor, William, October, 1906.
Manager, The Pawtucket Gas Company, 231 Main Street, Pawtucket, Rhode Island.

McGurty, William J., March, 1912.
The Bartlett Hayward Company, 3309 Bateman Avenue, Baltimore, Maryland.

McIlhenny, James S., October, 1906.
Engineer, Washington Gas Light Company, 413 10th Street, N. W., Washington, District of Columbia.

McIlhenny, John D., October, 1906.
Managing Director, Portsmouth (Va.) Gas Company, 1339 Cherry Street, Philadelphia, Pennsylvania.

McIntyre, Andrew, September, 1908. (P)
Superintendent, Public Service Company of Northern Illinois, University and Maple Avenues, Evanston, Illinois.

McKay, William E., October, 1906. (P)
Vice-President and General Manager, New England Gas & Coke Company, 111 Devonshire Street, Boston, Massachusetts.

McKee, G. W., October, 1906. (P)
President and Manager, Eclipse Fuel Engineering Company, 100 Forbes Street, Rockford, Illinois.

McKenzie, W. H., October, 1906. (P)
General Manager, Wyandotte County Gas Company, 6th Street and Minnesota Avenue, Kansas City, Kansas.

McLean, George, October, 1906. (P)
President and Manager, The Key City Gas Company, 669 Main Street, Dubuque, Iowa.

McLean, H. B., March, 1908. (P)
General Superintendent, Gas Appliance Department, Consolidated Gas Company, 130 East 15th Street, New York, New York.

McLeod, James E., September, 1916.
Comptroller, Laclede Gas Light Company, 1017 Olive Street, St. Louis, Missouri.

McMillin, Emerson, October, 1906.
President, Grand Rapids Gas Light Company, 120 Broadway, New York, New York.

McMillin, Marion, March, 1909.
Assistant Secretary, American Light & Traction Company, 120 Broadway, New York, New York.

McQueston, William Morton, March, 1914.
Superintendent Gas Works, Lawrence Gas Company, 34 Marston Street, Lawrence, Massachusetts.

MacArthur, Donald, September, 1913. (P)
Manager, Seaboard By-Products Coke Company, P. O. Box No. 8, Five Corner Station, Jersey City, New Jersey.

Macbeth, A. B., October, 1906. (P)
Vice-President and General Manager, Southern California Gas Company, Garland Building, Los Angeles, California.

Macbeth, George T., October, 1906. (P)
Chief Gas Engineer, Westchester Lighting Company, First Avenue and First Street, Mount Vernon, New York.

Macdonald, George, October, 1906.
President and General Manager, Nassau and Suffolk Lighting Company of Freeport, 149 Broadway, New York, New York.

MacDonald, Robert B., September, 1916.
General Manager, Fort Dodge Gas & Electric Company, Fort Dodge, Iowa.

MacIntosh, Walter L., March, 1909.
Chief Draftsman, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Mackie, G. W., September, 1913. (P)
Assistant Superintendent, Milwaukee Coke & Gas Company, Colby-Abbott Building, Milwaukee, Wisconsin.

MACKLIN, A. FRED, September, 1911. (P)
Engineer's Assistant, Manufacturing Department, Consolidated Gas Company, 130 East 15th Street, New York, New York.

MACLEOD, DANIEL TATE, March, 1914. (P)
Engineer, Otto Coking Company, 6 Church Street, New York, New York.

MACSWEENEY, JOSEPH P., March, 1911. (P)
Manager Domestic Sales Department, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

MACY, CARLTON, October, 1906.
President, Queens Borough Gas & Electric Company, 345 Central Avenue, Far Rockaway, New York.

MAINLAND, SINCLAIR, October, 1906.
Treasurer, Continental Public Utilities Company, Oshkosh, Wisconsin.

MAINLAND, WILLIAM, October, 1906.
President, Continental Public Utilities Company, Oshkosh, Wisconsin.

MALONE, M. E., October, 1906.
Manager Coke Department, Denver Gas & Electric Light Company, 900 15th Street, Denver, Colorado.

MALONEY, ANDREW P., September, 1907.
Official of Gas Companies, Lakewood (N. J.) Gas Company, 2116 Venango Street, Philadelphia, Pennsylvania.

MALONEY, MARTIN, 2D, March, 1913.
Assistant to Superintendent, City Gas Light Company, 927 Central Avenue, Ocean City, New Jersey.

MANGE, J. I., September, 1916.
President, Kentucky Public Service Company, 43 Exchange Place, New York, New York.

MANLY, FRED G., September, 1914. (P)
Superintendent, 22d Street Plant, Peoples Gas Light & Coke Company, 2250 South Racine Avenue, Chicago, Illinois.

MANN, HOWARD E., October, 1906.
Engineer, Montreal Light, Heat & Power Company, Montreal, Canada.

MANSFIELD, JOSEPH HUGH, March, 1914.
Superintendent, Department of Mains and Services, Consolidated Gas Company, 300 West 66th Street, New York, New York.

Manson, D. Edgar, September, 1914.
Vice-President, Charles H. Tenney & Company, 201 Devonshire Street, Boston, Massachusetts.

Markley, Joseph C., October, 1906. (P)
Chief Engineer, Metropolitan Gas & Electric Company, 111 West Monroe Street, Chicago, Illinois.

Marks, R. J., October, 1906.
Superintendent, City Gas Company, Norfolk, Virginia.

Marrow, George Peek, September, 1910.
Engineer, Gas Engineer's Dept., Consolidated Gas, Electric Light & Power Company, 100 Lexington Street, Baltimore, Maryland.

Marshall, F. L., October, 1906.
Manager, Gas Light Company of Augusta, 704 Broad Street, Augusta, Georgia.

Marshall, William H., October, 1906.
Assistant to Third Vice-President, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Martin, Edmund H., September, 1908.
Commercial Agent, Des Moines Gas Company, 412 West 7th Street, Des Moines, Iowa.

Martin, Eugene S., September, 1909.
Superintendent, Westchester Lighting Company, Mamaroneck Avenue, White Plains, New York.

Martin, John, October, 1906.
Room 411, 332 Pine Street, San Francisco, California.

Martin, John Gordon, September, 1912.
Secretary and General Manager, Gas & Electric Light Company, 19 East Washington Street, Greencastle, Indiana.

Mason, John T., October, 1906. (P)
Superintendent Third Ward Works, Milwaukee Gas Light Company, 129 25th Street, Milwaukee, Wisconsin.

Mather, John L., September, 1908.
General Manager, Counties Gas & Electric Company, Ardmore, Pennsylvania.

Mathews, Eugene Hamilton, September, 1908. (P)
Superintendent, Citizens' Works, Brooklyn Union Gas Company, 5th and Hoyt Streets, Brooklyn, New York.

MATLACK, WILLIAM H., JR., March, 1914.
Gas Light Company of Augusta, 704 Broad Street, Augusta, Georgia.

MAXON, J. H., October, 1906. (P)
General Manager, Central Indiana Gas Company, Muncie, Indiana.

MAYER, JOSEPH, September, 1914.
President, The Coast Gas Company, Belmar, New Jersey.

MAYERS, J. ALEX., October, 1906. (P)
Gas Engineer; President, Public Service Construction Company, 30 Broad Street, New York, New York.

MEAD, GILES W., September, 1908.
President, Indiana Natural Gas & Oil Company, The Linde Air Products Company, 42d Street Building, New York, New York.

MELLICK, THOS L., September, 1907.
Engineer, Central Division, Public Service Gas Company, 249 East 4th Street, Plainfield, New Jersey.

MELONEY, CHARLES WESLEY, September, 1916.
Assistant Engineer, Henry I Lea, Consulting Gas Engineer, Peoples Gas Building, Chicago, Illinois.

MENDEZ, ABNER JOHN, September, 1916.
Superintendent's Assistant, Holder Distribution Dept., Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

MERCHANT, O. A., JR., March, 1907. (P)
Manager, Bangor Gas Light Company, 18 Central Street, Bangor, Maine.

MERRITT, ALBERT H., October, 1906.
General Manager, Niagara Falls Gas & Electric Light Company, 306 Niagara Street, Niagara Falls, New York.

MERRITT, W. H., October, 1906.
General Manager, Bartlesville Interurban Railway Company, Bartlesville, Oklahoma.

MILLARD, FREDERICK CHAS., September, 1907.
Consulting Gas Engineer, 426 Marsh-Strong Building, Los Angeles, California.

MILLER, ALTEN S., October, 1906.
Vice-President, Humphreys & Miller, Inc., 165 Broadway, New York, New York.

Miller, Carroll, October, 1906. (P)
General Manager, Western United Gas & Electric Company, 36 Lincoln Way, Aurora, Illinois.

Miller, C. O. G., October, 1906.
President, Pacific Lighting Company, 519 California Street, San Francisco, California.

Miller, Daniel, March, 1915.
Chemist, The Barber Asphalt Company, Maurer, New Jersey; 35 Bryant Terrace, Rahway, New Jersey.

Miller, H. C., September, 1913.
Treasurer, Northern Indiana Gas & Electric Company, 571 Hohman Street, Hammond, Indiana.

Miller, Robt. C., September, 1909.
Assistant Superintendent, Coke Department, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Miller, Robert S., October, 1906. (P)
Manager, Jackson County Light, Heat & Power Company, 210 West Maple Avenue, Independence, Missouri.

Miller, Thomas David, October, 1906. (P)
Special Representative for E. M. Mancourt, Western Mgr., The Consolidation Coal Company, 910 Fisher Bldg., Chicago, Illinois.

Miller, V. A., September, 1907. (P)
Superintendent and New Business Manager, Canandaigua Gas Light Company, 66 South Main Street, Canandaigua, New York.

Miller, William A., October, 1906. (P)
Chief Engineer, Stacey Bros. Construction Company, 2315 Krouse Avenue, Cincinnati, Ohio.

Mills, Samuel Archibald, March, 1911.
Assistant Superintendent, Williamsburg Works, Brooklyn Union Gas Company, Foot of North 12th Street, Brooklyn, New York.

Milton, Marshall M., September, 1912.
Manager, Roanoke Gas Light Company, Roanoke, Virginia.

Mitchell, Curtis S., September, 1914.
Controller, Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

Mitchell, H. J., September, 1914.
Joliet, Illinois.

Mockett, W. E., October, 1906.
Chief Engineer, Gas Department, Havana Electric Railway, Light & Power Company, Monte No. 1, Havana, Cuba.

Montgomery, George A., September, 1916.
Vice-President and General Manager, Lincoln Gas & Electric Company, Lincoln, Nebraska.

Montgomery, John E., September, 1914.
Superintendent, Gas Department, Birmingham Railway, Light & Power Company, 2100 First Avenue, Birmingham, Alabama.

Moore, Edwin A., March, 1908.
President, American Coke & Gas Construction Company, Camden, N. J.; 2216 North 52d Street, Philadelphia, Pennsylvania.

Moorhouse, Louis B., September, 1908.
With Doherty Operating Company, Caney, Kansas.

Morehead, John M., October, 1906. (P)
Consulting Engineer, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

Morgan, John Eyre, October, 1906.
408 Tioga Street, Johnstown, Pennsylvania.

Morrell, Edward E., October, 1906. (P)
Treasurer, National Gas & Water Company, 108 South La Salle Street, Chicago, Illinois.

Morris, Henry Charles, September, 1912.
General Manager, Dallas Gas Company, 2016 Jackson Street, Dallas, Texas.

Morris, Robert C., Jr., October, 1906.
200 South High Street, Bethlehem, Pennsylvania.

Morris, W. Cullen, October, 1906.
Engineer of Construction, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Morris, William Giles, March, 1911.
Chief Clerk, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Morrison, Henry K., October, 1906. (P)
General Manager, Lynn Gas & Electric Company, 90 Exchange Street, Lynn, Massachusetts.

Morton, Albert B., September, 1907.
Superintendent, Rome Gas, Electric Light & Power Company, 139 North James Street, Rome, New York.

Morton, F. N., October, 1906.
Engineer, with The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Moses, Frank D., October, 1906.
Engineer, Gas Engineering Company, 7 North Stockton Street, Trenton, New Jersey.

Moulton, Walter Ross, September, 1915.
Illuminating Engineer, Consolidated Gas, Electric Light & Power Company, 325 North Charles Street, Baltimore, Maryland.

Mueller, M. E., September, 1909. (P)
Superintendent Plant A, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

Mulholland, S. E., October, 1906. (P)
Vice-President, Northern Indiana Gas & Electric Company, 1117 West Jefferson Street, Fort Wayne, Indiana.

Munroe, Charles A., March, 1916. (P)
Vice-President, Public Service Company of Northern Illinois, 1310 Edison Building, Chicago, Illinois.

Munson, Ralph Ira, March, 1912.
Secretary, Bridgeport Gas Light Company, 799 Main Street, Bridgeport, Connecticut.

Murdock, James W., October, 1906.
General Superintendent, Underlying Companies, Associated Gas & Electric Company, Ithaca, New York.

Murdock, S. T., October, 1906.
Managing Director, Indiana Lighting Company, 1414 Merchants Bank Building, Indianapolis, Indiana.

Murdock, W. J., September, 1916. (P)
General Foreman, Coal Products Manufacturing Company, Joliet, Illinois.

Murphy, Edward J., September, 1913.
Assistant Chemist, Brooklyn Union Gas Company, 191 St. James Place, Brooklyn, New York.

Murphy, William J., September, 1916.
District Superintendent, Laclede Gas Light Company, 2655 Adams Street, St. Louis, Missouri.

Murray, Edward, S., September, 1916.
Superintendent, Inspection and Maintenance Department, Laclede Gas Light Company, 4205 Flad Avenue, St. Louis, Missouri.

Murray, John J., March, 1911.
Superintendent, Philadelphia Company, 435 6th Avenue, Pittsburgh, Pennsylvania.

Myers, Edward Brittain, October, 1906. (P)
Appliance Engineer, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Myers, Joseph B., October, 1906.
Commercial Agent, The United Gas Improvement Company, 134 North 13th Street, Philadelphia, Pennsylvania.

Naphtaly, Samuel L., October, 1906.
President, Nevada Narrow Gauge Railroad Company, 305 Hobart Building, San Francisco, California.

Nettles, Rosco, September, 1911.
Secretary, Tampa Gas Company, Tampa, Florida.

Nettleton, Charles H., October, 1906. (P)
President, Derby Gas Company and New Haven Gas Light Company, 22 Elizabeth Street, Derby, Connecticut.

Nevanas, Harold Honey, March, 1914.
General Coal Gas Foreman, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Newberry, F. E., October, 1906.
584 South Chicago Avenue, Kankakee, Illinois.

Nicholls, Charles J., September, 1916.
Superintendent, Laclede Gas Light Company, 2801 Gravois Avenue, St. Louis, Missouri.

Nichols, Walter E., March, 1916. (P)
Superintendent, Northern Indiana Gas & Electric Company, Plymouth, Indiana.

Nichols, William B., September, 1912.
Assistant General Manager, Citizens Gas Light Company, 11 Granite Street, Quincy, Massachusetts.

Nickerson, Franklin Hezekiah, March, 1911.
Chief Statistician, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Nickerson, Harry L. R., March, 1916. (P)
Assistant to Superintendent, New England Gas & Coke Company, Everett, Masachusetts.

Noble, Jay A., September, 1916.
Superintendent Gas Department, Lockport Light, Heat & Power Company, 28 High Street, Lockport, New York.

Norcross, J. Arnold, October, 1906.
Secretary and Treasurer, New Haven Gas Light Company, 80 Crown Street, New Haven, Connecticut.

Norris, Rollin, October, 1906.
General Superintendent, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

North, Edwin, March, 1910.
Purchasing Agent, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Norton, Walter F., October, 1906.
Superintendent, Gas Department, Nashua Light, Heat & Power Company, 70 East Pearl Street, Nashua, New Hampshire.

Norton, William J., September, 1913.
Special Consulting Work Engineer, 111 West Monroe Street, Chicago, Illinois.

Nute, Joseph E., October, 1906. (P)
Manager, Fall River Gas Works Company, 155 North Main Street, Fall River, Massachusetts.

O'Connell, John, March, 1913.
General Foreman of Gas Making, Consolidated Gas Company, 501 East 21st Street, New York, New York.

O'Donnell, Chas. J., April, 1908. (P)
Assistant to Engineer of Tests, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Odrich, Erich, September, 1914.
Engineer and Manager, Manila Gas Corporation, Manila, Philippine Islands.

Offutt, M. Webb, March, 1908.
Engineer, Care of Engineers' Club, 32 West 40th Street, New York, New York.

Okamoto, Sakura, March, 1909.
Chief Engineer and Manager, Nagoya Gas Company, Nagoya, Japan.

Olds, Howard L., October, 1906.
Vice-President, Twin State Gas & Electric Company, Brattleboro, Vermont.

Olmsted, George G., October, 1906.
105 South La Salle Street, Chicago, Illinois.

Olsen, Edward, September, 1914. (P)
Superintendent of Manufacture, Benton Harbour-St. Joseph Gas & Fuel Company, 211 Lake Avenue, Benton Harbour, Michigan.

Osborn, Arthur H., March, 1914.
President, City Gas Light Company, 11th and Haven Avenues, Ocean City, New Jersey.

Osborne, Willard B., October, 1906. (P)
General Manager, Lowell Gas Light Company, 27 Wyman Street, Lowell, Massachusetts.

Osthoff, Otto E., October, 1906.
Vice-President and Chief Engineer, H. M. Byllesby & Company, Insurance Exchange Building, Chicago, Illinois.

Otten, Charles, Jr., March, 1907. (P)
Superintendent, Haverhill Gas Light Company, 28 Washington Square, Haverhill, Massachusetts.

Owens, John Henry, September, 1916.
Superintendent of Underground Work, Western United Gas & Electric Company, 871 Highland Avenue, Elgin, Illinois.

Paige, Clifford E., March, 1909. (P)
Manager, Malden & Melrose Gas Light Company, 137 Pleasant Street, Malden, Massachusetts.

Palmer, A. J., March, 1909.
Superintendent of Works, Bridgeport Gas Light Company, Howard Avenue Works, Bridgeport, Connecticut.

Palmer, E. H., October, 1906.
President, Auburn Gas Company, Seneca Falls & Waterloo Gas Light Company, Geneva, New York.

Palmer, Harry C., October, 1906.
Engineer, Buffalo Gas Company, 186 Main Street, Buffalo, New York.

Papst, Hilmar Maximilian, March, 1911.
General Manager, Portland Gas & Coke Company, 5th and Yamhill Streets, Portland, Oregon.

Park, Frederick Edwin, March, 1914. (P)
307 East Church Street, Adrian, Michigan.

Parker, Frank H., October, 1906.
Manager, Burlington Light & Power Company, 102 South Winooski Avenue, Burlington, Vermont.

PARKER, JOSEPH SMITH, October, 1906. (P)
Superintendent, Frankford District, United Gas Improvement Company, 4427 Frankford Avenue, Philadelphia, Pennsylvania.

PARKER, RICHARD MARSH, October, 1906.
Macedon, New York.

PARKHURST, GEORGE W., September, 1914. (P)
Secretary, New York Mutual Gas Light Company, 142 East 15th Street, New York, New York.

PARSHALL, A., March, 1913.
Consulting Engineer, Appraising Gas and Electric Properties, New York Athletic Club, Central Park South, New York, N. Y.

PARTRIDGE, WARREN, September, 1909.
General Manager, Penn Public Service Company, Clearfield, Pennsylvania.

PATT, EVERETT I., March, 1914.
Superintendent, Pawtucket Gas Company, 231 Main Street, Pawtucket, Rhode Island.

PATTEN, JOHN A., September, 1916.
General Manager, Elkhart Gas & Fuel Company, Elkhart, Indiana.

PATERSON, ALBERT B., September, 1916.
General Manager, Meridian Light & Railway Company, Meridian, Mississippi.

PATTERSON, FREDK. H., September, 1916. (P)
Assistant Auditor, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

PAYNE, A. I., October, 1906.
Consulting Gas Engineer, Post Office Box 571, Calgary, Alberta, Canada.

PEARSON, J. A., October, 1906.
Purchasing Agent, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

PEARSON, W. H., October, 1906.
34 North Sherbourne Street, Toronto, Ontario, Canada.

PEASE, LUTHER M., September, 1916.
Manager, Peoples Lighting, Heating & Power Company, 16 Depot Square, Barre, Vermont.

PECK, HENRY W., March, 1912. (P)
Vice-President and General Manager, Mohawk Gas Company, 511 State Street, Schenectady, New York.

PEEBLES, EDWIN C., March, 1914.
General Manager, Rockland Light & Power Company, 2 North Broadway, Nyack, New York.

PELTON, BERT F., October, 1906.
Superintendent Gas Distribution, St. Paul Gas Light Company, 6th and Jackson Streets, St. Paul, Minnesota.

PENINGTON, DUDLEY W., March, 1912. (P)
Assistant Supt., South Division Street Dept., Peoples Gas Light & Coke Company, 38 West 64th Street, Chicago, Illinois.

PERKINS, JAY HUGH, October, 1906.
Consulting Electrical Engineer, United Gas & Electric Engineering Corporation, 61 Broadway, New York, New York.

PERRY, JOSEPH A., October, 1906. (P)
Assistant to General Superintendent, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

PETTES, W. H., October, 1906.
General Auditor, Public Service Gas Company, 80 Park Place, Newark, New Jersey.

PETTY, JOHN P., March, 1915.
Room 1106, 11th Floor, 790 Broad Street, Newark, New Jersey.

PHILBRICK, JOSEPH E., September, 1911.
Care of New England Manufacturing Company, North Woburn, Massachusetts.

PIPKIN, HUMPHREY H., September, 1916.
General Foreman, Distribution Department, Laclede Gas Light Company, 2801 Gravois Avenue, St. Louis, Missouri.

PIPKIN, JESSE E., September, 1913. (P)
Superintendent, Station B, Laclede Gas Light Company, Laclede Gas Building, St. Louis, Missouri.

PLUMMER, H. W., October, 1906.
Manager, Asheville Power & Light Company, Asheville, North Carolina.

POLK, ROGER W., October, 1906. (P)
Consulting Gas Engineer, 193 Washington Avenue, Providence, Rhode Island.

Pollitt, L. Irving, October, 1906.
Vice-President and General Manager, Southern Gas & Electric Corporation, 213 Courtland Street, Baltimore, Maryland.

Poole, Eugene Warren, September, 1915.
Treasurer and Assistant Secretary, Syracuse Lighting Company, 335 South Warren Street, Syracuse, New York.

Porter, Dugald Gilbert, September, 1915. (P)
Assistant Manager, Peoples Power Company, Safety Building, Rock Island, Illinois.

Porter, Edward, September, 1913.
Special Accountant, General Auditor's Dept., United Gas Improvement Co., 1401 Arch Street, Philadelphia, Pennsylvania.

Porter, Joseph F., October, 1906.
1809 Victoria Drive, Los Angeles, California.

Porter, Roland G., October, 1906. (P)
Engineer, Rockford Gas Light & Coke Company, Gas Works Office, Avon Street, Rockford, Illinois.

Potter, Ormsby F., March, 1914.
Assistant to General Auditor, Public Service Gas Company, 80 Park Place, Newark, New Jersey.

Powell, David A., September, 1909. (P)
Engineer's Assistant, Milwaukee Gas Light Company, 182 Wisconsin Street, Milwaukee, Wisconsin.

Pratt, Charles Oland, March, 1914.
Superintendent of Construction, Portland Gas Light Company, 40 West Commercial Street, Portland, Maine.

Pratt, Edward G., October, 1906. (P)
Consulting Gas Engineer and President, Boone (Iowa) Gas Company, 627 Peoples Gas Building, Chicago, Illinois.

Prichard, Chas. R., September, 1909.
Superintendent, Beverly Gas & Electric Company, Beverly, Massachusetts.

Priest, George Heywood, March, 1910.
General Manager, Brockton Gas Light Company, 46 Centre Street, Brockton, Massachusetts.

Printz, Charles H., October, 1906. (P)
Vice-President, Gas Machinery Company, 1900 Euclid Avenue, Cleveland, Ohio.

PURCELL, THEO. V., October, 1906. (P)
Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

PUTNAM, WILLIAM R., October, 1906.
New Business Manager, Utah Power & Light Company, Kearns Building, Salt Lake City, Utah.

QUACKENBUSH, CHARLES H., October, 1906. (P)
Manager, St. Clair County Gas & Electric Company, 414 Missouri Avenue, East St. Louis, Illinois.

QUINN, ANDREW K., October, 1906. (P)
President, Newport Gas Light Company, 181 Thames Street, Newport, Rhode Island.

RAABE, CHARLES, March, 1910. (P)
Assistant to Superintendent, Consolidated Gas Company, 501 East 21st Street, New York, New York.

RAFFERTY, JAMES ALOYSIUS, September, 1910.
Superintendent, Calumet Shop, Peoples Gas Light & Coke Company, 9555 Houston Avenue, Chicago, Illinois.

RAHN, BRUNO, March, 1914. (P)
Engineering Department, Milwaukee Gas Light Company, 182 Wisconsin Street, Milwaukee, Wisconsin.

RAMSBURG, CHARLES J., October, 1906. (P)
Second Vice-President, H. Koppers Company, First National Bank Building, 511 Wood Street, Pittsburgh, Pennsylvania.

RAMSDELL, GEORGE G., October, 1906. (P)
Secretary and Treasurer, American Gas Institute, 29 West 39th Street, New York, New York.

RANDOLPH, WILLIAM W., October, 1906.
Consulting Engineer, Woolworth Building, 233 Broadway, New York, New York.

RAY, WILLIAM DANIEL, March, 1911.
Manager, General Gas & Electric Company, Easton, Pennsylvania.

RAYMOND, CHARLES ABEL, March, 1916.
Assistant to Superintendent, New England Gas & Coke Company, Everett, Massachusetts.

REDD, JOHN BARNETT, September, 1915. (P)
Sales Department, Davis-Bournonville Company, Marion Station, Jersey City, New Jersey.

Reed, David A., March, 1916. (P)
Manager, Water & Light Department, Division of Public Utilities, Commercial Club Building, Duluth, Minnesota.

Reed, James H., Jr., September, 1909.
General Purchasing Agent, Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

Reed, Joseph A., March, 1911.
Assistant General Superintendent, Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

Reeside, Howard S., March, 1914.
President, Washington Gas Light Company, 413 10th Street, N. W., Washington, D. C.

Reimers, Frederick William, September, 1912.
General Manager, Natalbany Lumber Company, Hammond, Louisiana.

Reinach, Hugo B., March, 1911. (P)
Assistant General Superintendent, Commercial Dept., Consolidated Gas Company, 130 East 15th Street, New York, New York.

Reinhard, Solon A., September, 1910. (P)
Assistant Superintendent of North Station, Peoples' Gas Light & Coke Company, 1129 Dearborn Avenue, Chicago, Illinois.

Reinicker, Charles E., March, 1912. (P)
Associate Gas Engineer, Bureau of Standards, Washington, District of Columbia.

Reitemeyer, A. F., October, 1906.
Secretary and Treasurer, Perth Amboy Gas Light Company, 196 Smith Street, Perth Amboy, New Jersey.

Rew, Irwin, October, 1906.
Vice-President, DeKalb County (Ill.) Gas Company, 108 South LaSalle Street, Chicago, Illinois.

Rhoades, William R., October, 1906.
General Manager, Northern Central Gas Company, Williamsport, Pennsylvania.

Rice, Henry L., October, 1906. (P)
Consulting Engineer, First National Bank Building, Milwaukee, Wisconsin.

Richards, J. L., September, 1907.
President and General Manager, Boston Consolidated Gas Company, 24 West Street, Boston, Massachusetts.

Rieha, Edward L., October, 1906. (P)
Secretary, Sumter Gas & Power Company, Sumter, South Carolina; 213 Courtland Street, Baltimore, Maryland.

Riggins, John A., March, 1914.
President, New Jersey Northern Gas Company, Court House Square Building, Camden, New Jersey.

Riley, Henry M., September, 1915. (P)
Assistant Supt., Distribution Dept., Consolidated Gas, Electric Light & Power Co., 1068 North Front St., Baltimore, Maryland.

Riselay, William S., October, 1906.
Secretary and Treasurer, Buffalo Gas Company and Peoples Gas Light & Coke Company, 186 Main Street, Buffalo, New York.

Ritter, Charles S., October, 1906.
Secretary and Assistant Treasurer, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

Rix, Austin J., March, 1915.
Superintendent, Gas Department, Pacific Gas & Electric Company, 365 Mission Street, San Rafael, California.

Roberts, E. C., September, 1907.
Division Agent, Public Service Gas Company, 114 Main Street, Hackensack, New Jersey.

Roberts, F. M., October, 1906. (P)
Manager, Haverhill Gas Light Company, 28 Washington Square, Haverhill, Massachusetts.

Roberts, George J., October, 1906.
First Vice-President, Public Service Gas Company, 759 Broad Street, Newark, New Jersey.

Roberts, Geo. W., March, 1909.
Treasurer, Bridgeport Gas Company, 799 Main Street, Bridgeport, Connecticut.

Robinson, Frank Ellsworth, September, 1916. (P)
District Manager, Western United Gas & Electric Company, 36 Lincoln Way, Aurora, Illinois.

Robison, Charles D., October, 1906.
Consulting Engineer, Forstall & Robison, 84 William Street, New York, New York.

Rochat, Henry, October, 1906.
Superintendent of Manufacture, Glens Falls Gas & Electric Company, Glens Falls, New York.

Rodgers, William Joseph, September, 1913.
Assistant Superintendent of Distribution, Public Service Gas Company, 2d and Cherry Streets, Camden, New Jersey.

Roeser, Charles J., September, 1907. (P)
Engineer, East 5th Street Works, Public Service Gas Company, Paterson, New Jersey.

Rogers, Linies Boswick, September, 1916.
Superintendent, Lansing Fuel & Gas Company, Lansing, Michigan.

Rogers, Fred Alfred, September, 1913.
Secretary and General Manager, Watertown Light & Power Company, 137 Arsenal Street, Watertown, New York.

Rogers, John McClelland, September, 1908.
Assistant to Purchasing Agent, Public Service Gas Company, 759 Broad Street, Newark, New Jersey.

Rogers, W. H., October, 1906.
Agent, Passaic Division, Public Service Gas Company, 188 Ellison Street, Paterson, New Jersey.

Roohan, Patrick F., October, 1906.
Superintendent, Adirondack Electric Power Corporation, 491 Broadway, Saratoga Springs, New York.

Roper, George D., October, 1906. (P)
President, Eclipse Gas Stove Company, Vice-President, Boone (Iowa) Gas Company, Rockford, Illinois.

Rosenquest, Eugene H., October, 1906.
President and General Manager, Bronx Gas & Electric Company, Walker and Frisbie Avenues, Westchester, New York.

Rosenthal, Albert, October, 1906.
General Contractor, Claiborne, Johnston & Company, 910 Garrett Building, Baltimore, Maryland.

Rossman, G. M., October, 1906.
Treasurer, Keene Gas & Electric Company, 18 Roxbury Street, Keene, New Hampshire.

Rowland, Charles L., October, 1906.
Consulting Engineer, American Welding Company, Carbondale, Pennsylvania.

Rowland, William L., October, 1906.
Chemical Engineer, Henry Bower Chemical Manufacturing Company, 2815 Gray's Ferry Road, Philadelphia, Pennsylvania.

Royce, Frederick P., October, 1906.
Vice-President, Stone & Webster Management Association, Inc., 147 Milk Street, Boston, Massachusetts.

Ruegenberg, John M., March, 1907. (P)
Supt., Northern Liberties Gas Company, United Gas Improvement Co., 3d and Brown Streets, Philadelphia, Pennsylvania.

Runner, R. K., October, 1906.
Secretary and Manager, Gas Company, 709 Kelly Street, Charles City, Iowa.

Rusby, John M., October, 1906.
Engineer of Tests, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Russell, Herman, September, 1907. (P)
Assistant General Manager, Rochester Railway & Light Company, 308 Laburnum Crescent, Rochester, New York.

Russell, Walter Marvin, September, 1916.
Manager, Emporia Gas Company, Emporia, Kansas.

Rutledge, Fred J., September, 1909.
Commercial Agent, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Sands, Howard T., March, 1913.
General Manager, Malden & Melrose Gas Light Company, 201 Devonshire Street, Boston, Massachusetts.

Sargeant, Frank Washburn, September, 1908. (P)
Superintendent of Distribution, Citizens Gas Company, 31 South Pennsylvania Street, Indianapolis, Indiana.

Sargent, Fred H., October, 1906.
Assistant Agent, Lawrence Gas Company, 370 Essex Street, Lawrence, Massachusetts.

Savage, George W., September, 1916.
Superintendent of Distribution, Philadelphia Suburban Gas & Electric Company, Chester, Pennsylvania.

Schaaf, August Henry, March, 1914.
Photometric Inspector, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Schaddelee, Richard, October, 1906. (P)
Vice-President, United Light & Railway Company, 411 Michigan Trust Building, Grand Rapids, Michigan.

SCHAFER, FREDK. J., September, 1916.
Superintendent, Southern California Gas Company, 609 Garland Building, Los Angeles, California.

SCHAUER, FRANK F., October, 1906.
Assistant Engineer, Kansas City Gas Company, 910 Grand Avenue, Kansas City, Missouri.

SCHENCK, RUDOLPH, October, 1906. (P)
Superintendent, Drafting Department, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

SCHERCK, LEON H., October, 1906.
Sales Manager, Central Hudson Gas & Electric Company, 50 Market Street, Poughkeepsie, New York.

SCHILLER, CHARLES C., October, 1906.
Watervliet, Michigan.

SCHINDLER, MORRIS DANIEL, September, 1912.
Augusta, Georgia.

SCHLESINGER, FERDINAND, March, 1914.
President, Milwaukee Coke & Gas Company, 1112 First National Bank Building, Milwaukee, Wisconsin.

SCHMIDT, EDGAR HENRY, September, 1914.
Fitting Shop Superintendent, Northern Union Gas Company, 1815 Webster Avenue, New York, New York.

SCHMIDT, F. W., October, 1906.
Division Agent, Public Service Gas Company, 84 Sip Avenue, Jersey City, New Jersey.

SCHNEIDER, PHILIP J., March, 1911. (P)
Treasurer, Central Union Gas Company, 519 Courtlandt Avenue, New York, New York.

SCHOBEL, FREDERICK A., March, 1911. (P)
Superintendent of Distribution, Municipal Gas Company, 1131 Broadway, Albany, New York.

SCHROEDER, ALBERT GEORGE, September, 1912.
Purchasing Agent, Grand Rapids Gas Light Company, Ottawa and Pearl Streets, Grand Rapids, Michigan.

SCHULTZ, WALTER F. H., March, 1915.
Chief Engineer, Dessauer Vertical Oven Co., Berlin; United Gas Improvement Co., 1401 Arch St., Philadelphia, Pennsylvania.

SCHUTT, HARRY S., October, 1906. (P)
General Manager, C. H. Geist Company, 1127 Land Title Building, Philadelphia, Pennsylvania.

SCHWABE, WALTER P., March, 1911.
General Manager, Northern Connecticut Light & Power Company, 15 Central Street, Thompsonville, Connecticut.

SCHWARM, C. A., October, 1906.
General Superintendent, Henry M. Wallace Company, 612 Union Trust Building, Detroit, Michigan.

SCOBELL, E. C., October, 1906.
Auditor, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

SCOFIELD, THOMAS, September, 1910.
Illuminating Engineer, Consolidated Gas Company, 130 East 15th Street, New York, New York.

SCOTT, ALEXANDER H., September, 1908.
Engineer, Peoples Gas Light Company, 39 Hanover Street, Manchester, New Hampshire.

SCOTT, JOHN JOSEPH, September, 1912.
Superintendent, Lewiston Gas Light Company, 88 Shawmut Street, Lewiston, Maine.

SCOTT, JOHN M., September, 1908.
Secretary and Treasurer, Kansas City Gas Company, 910 Grand Avenue, Kansas City, Missouri.

SCOTT, ROSSITER STOCKTON, March, 1908.
Assistant Engineer, Consolidated Gas, Electric Light & Power Company, Baltimore, Maryland.

SCRANTON, GEORGE H., October, 1906.
Secretary, Derby Gas Company, 22 Elizabeth Street, Derby, Connecticut.

SCRANTON, WORTHINGTON, October, 1906. (P)
Vice-President, Hyde Park Gas Company, 115 Wyoming Avenue, Scranton, Pennsylvania.

SEARLE, ROBERT M., October, 1906.
Vice-President, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

SECORD, WARREN L., October, 1906.
General Superintendent of Meters, Westchester Lighting Company, First Avenue and First Street, Mt. Vernon, New York.

Seddon, Samuel Venable, September, 1913.
Superintendent, Metropolitan Works, Brooklyn Union Gas Company, 12th Street and Gowanus Canal, Brooklyn, New York.

Serrill, William J., October, 1906. (P)
Engineer of Distribution, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Seymour, Fredk. Warner, September, 1912. (P)
Superintendent of Manufacture, Grand Rapids Gas Light Company, Grand Rapids, Michigan.

Seymour, William W., October, 1906.
President, Gray's Harbor Gas Company of Aberdeen, Washington, 324 Tacoma Building, Tacoma, Washington.

Shaeffer, John Wallace, March, 1911. (P)
Superintendent, The Milwaukee Coke & Gas Company, 187 Greenfield Avenue, Milwaukee, Wisconsin.

Shattuck, A. F., October, 1906.
Hotel Angelus, Los Angeles, California.

Shattuck, John D., October, 1906.
General Manager, Philadelphia Gas & Electric Company, 6th and Welsh Streets, Chester, Pennsylvania.

Shaul, Clifford Dale, September, 1914. (P)
General Manager, Citizens Gas & Fuel Company, 636 Wabash Avenue, Terre Haute, Indiana.

Shaw, H. S., October, 1906.
Treasurer and Superintendent, Webster Electric Company, Webster, Massachusetts.

Shaw, John Cargill, September, 1913.
Assistant Superintendent, Mechanical Department, Astoria Light, Heat & Power Company, 530 Third Avenue, Astoria, New York.

Shepard, Frederick C., October, 1906. (P)
Superintendent, Minneapolis Gas Light Company, 16 Seventh Street, Minneapolis, Minnesota.

Shepard, Richard, Jr., September, 1912.
Supt. of Pavements and General Storekeeper, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Sherwood, E. J., October, 1906.
Manager, Mitchell Power Company, Mitchell, South Dakota.

Sherwood, M. S., September, 1907.
Agent, Gas Department, Public Service Gas Company, 446 Springfield Avenue, Summit, New Jersey.

Shiebler, Marvin, September, 1908.
Gas Engineer, 30 Church Street, New York, New York.

Shields, Henry C., March, 1913.
Vice-President and General Manager, Troy Gas Company, Troy, New York.

Shimomura, Kotaro, September, 1914.
Chief Engineer, Osaka Gas Company, Osaka, Japan.

Simons, Keating Lewis, September, 1907.
Vice-President and General Manager, El Paso Gas & Electric Company, El Paso, Texas.

Simpson, Colin C., March, 1911.
General Superintendent of Mains and Services, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Simpson, Henry, March, 1911. . .
Superintendent, Consolidated Gas Company, 112 West 42d Street, New York, New York.

Singer, Sidney Charles, March, 1908.
Superintendent of Distribution, Syracuse Lighting Company, 736 South Beech Street, Syracuse, New York.

Sinsel, Otis A., October, 1906.
Assistant Engineer, Detroit City Gas Company, 57 Webb Avenue, Detroit, Michigan.

Sissingh, Melchior Corstius, March, 1914.
Manager, Municipal Gas Works, Rotterdam, "Gemeente-Gasbedrijf," Oost-Zeedijk, Rotterdam.

Slade, Richmond E., October, 1906.
Engineer, Providence Gas Company, Turks Head Building, Providence, Rhode Island.

Slater, Surrey W., March, 1914.
Superintendent's Assistant, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Sloan, J. C., October, 1906.
Manager, Port Huron Gas Company, Port Huron, Michigan.

SMART, BURTON, September, 1915. (P)
Treasurer, Portland Gas Light Company, Post Office Box 668, Portland, Maine.

SMITH, A. J., October, 1906.
Superintendent, Concord Light & Power Company, 90 North Main Street, Concord, New Hampshire.

SMITH, CHARLES G., March, 1915.
Superintendent, Consolidated Gas Company, 130 East 15th Street, New York, New York.

SMITH, ELMER W., March, 1907. (P)
Manager, Consolidated Light & Power Company, Kewanee, Illinois.

SMITH, FREDK. M., September, 1916.
Superintendent of Distribution, Public Service Gas Company, 249 East 4th Street, Plainfield, New Jersey.

SMITH, GEO. P., JR., September, 1910. (P)
Superintendent, Old Colony Gas Company, Quincy Avenue, East Braintree, Massachusetts.

SMITH, H. M., March, 1914.
General Superintendent, Citizens Gas & Electric Company, 714 Bayard Street, Waterloo, Iowa.

SMITH, J. HENDERSON, September, 1913.
Chief Clerk, General Auditor's Dept., United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

SMITH, LOUIS C., September, 1913.
Manager, Fulton County Gas & Electric Company, 18 East Fulton Street, Gloversville, New York.

SMITH, OLIVER HOBSON, September, 1914. (P)
Assistant Superintendent, New Amsterdam Gas Company, Ravenswood Works, Long Island City, New York.

SMITH, RAYMOND H., March, 1909.
Vice-President, Eastern Wisconsin Electric Company, Fond du Lac, Wisconsin.

SMITH, SHALER G., March, 1914.
President, Modern Power Appliance Company, 212 North Main Street, Rockford, Illinois.

SNOW, WILLIAM H., October, 1906.
General Manager, New Bedford Gas & Edison Light Company, 693 Purchase Street, New Bedford, Massachusetts.

Snyder, Albert I., September, 1911.
Superintendent of Distribution, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

Snyder, Charles S., March, 1907. (P)
Superintendent, West Philadelphia District, United Gas Improvement Co., 4650 Market Street, Philadelphia, Pennsylvania.

Snyder, Harry L., March, 1911.
Secretary and Treasurer, New York & Queens Electric Light & Power Co., 444 Jackson Avenue, Long Island City, New York.

Sombart, W. E., October, 1906.
Secretary and Treasurer, Sombart Gas Company, Boonville, Missouri.

Spangenberg, Brewster H., October, 1906.
235 E. Orange Street, Lancaster, Pennsylvania.

Speaker, George S., March, 1912.
Treasurer and General Manager, Lebanon Gas & Fuel Company, 17 North 8th Street, Lebanon, Pennsylvania.

Spear, M. H., October, 1906.
Secretary and Manager, New York & Queens Gas Company, 88 Main Street, Flushing, New York.

Spencer, Elliott L., March, 1912.
Engineer, Central Union Gas Company, 905 East 138th Street, New York, New York.

Sperling, Nath. Jos., September, 1909.
Superintendent, Mechanical Department, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

Spitzglass, Jacob M., September, 1912. (P)
Mechanical Engineer, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

Spragle, L. D., October, 1906.
General Manager, Berwick Gas Company, 102 Mulberry Street, Berwick, Pennsylvania.

Squier, Harold Newton, September, 1912. (P)
Superintendent, Hyde Park Gas Company, 115 Wyoming Avenue, Scranton, Pennsylvania.

Stacey, Frederick A., October, 1906. (P)
President, Chillicothe Gas & Water Company, Chillicothe, Ohio.

Stack, Edward M., March, 1910.
General Superintendent, Hyde Park Gas Company, 115 Wyoming Avenue, Scranton, Pennsylvania.

Staniford, Arthur Fowler, March, 1908.
Vice-President, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Stannard, Clare N., October, 1906.
Secretary and Commercial Manager, Denver Gas & Electric Company, 900 15th Street, Denver, Colorado.

Stark, Arthur William, March, 1913. (P)
Engineer's Assistant, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Starzenski, Victor von, March, 1909. (P)
Assistant General Manager, Mohawk Gas Company, 511 State Street, Schenectady, New York.

Stealey, Lee G., March, 1912.
Manager, St. Charles Lighting Company, St. Charles, Missouri.

Steele, G. W., March, 1909.
Manager, Lehigh-Northampton Light, Heat & Power Company, 123 Bridge Street, Catasauqua, Pennsylvania.

Steinwedell, George, October, 1906.
Commercial Manager, St. Paul Gas Light Company, Sixth and Jackson Streets, St. Paul, Minnesota.

Steinwedell, W. E., October, 1906. (P)
Secretary, Gas Machinery Company, 1900 Euclid Avenue, Cleveland, Ohio.

Stevick, Crist H., October, 1906.
Superintendent, Ravenswood Works, New Amsterdam Gas Company, 58 Woolsey Street, Astoria, Long Island, New York.

Stewart, C. Howard, September, 1915.
Assistant to Secretary and Treasurer, Laclede Gas Light Company, 1017 Olive Street, St. Louis, Missouri.

Stewart, Samuel B., October, 1906.
General Contracting Agent, Philadelphia Company, and Consolidated Gas Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

Stiles, George Warren, September, 1912.
Superintendent, Fitchburg Gas & Electric Light Company, Fitchburg, Massachusetts.

Stiles, Linford Spearing, March, 1910. (P)
Construction Engineer, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Stillson, Howard G., October, 1906.
Manager, Boone Gas Company, Boone, Iowa.

Stilwell, John, September, 1909.
Engineer, Department of Meters, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Stirzel, Jacob W., October, 1906.
Superintendent of Holder Stations, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Stitzer, Ralph Bourquin, September, 1916.
Superintendent, Spokane Gas & Fuel Company, Spokane, Washington.

St. John, John, September, 1909.
Secretary and Treasurer, Madison Gas & Electric Company, 120 East Main Street, Madison, Wisconsin.

Stone, C. H., March, 1911.
Superintendent Station A, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

Stone, Frederick W., October, 1906.
Manager, The Ashtabula Gas Company, 6 Progress Street, Ashtabula, Ohio.

Strange, Harry Latimer, March, 1911.
Manager, Honolulu Gas Company, Ltd., Post Office Box 1379, Honolulu, Oahu, Hawaii.

Strecker, Alexander H., October, 1906.
Consulting Engineer, Public Service Gas Company, 235 Mt. Pleasant Avenue, Newark, New Jersey.

String, Joseph S., September, 1914.
130 Arlington Avenue, East Orange, New Jersey.

Strohn, C. B., October, 1906.
District Manager, Western United Gas & Electric Company, Elgin, Illinois.

Strohn, R. N., October, 1906.
Vice-President and Treasurer, Western United Gas & Electric Company, 36 Lincoln Way, Aurora, Illinois.

Stroud, Morris W., October, 1906.
President, The American Gas Company, 712 Locust Street, Philadelphia, Pennsylvania.

Stull, C. Rodman, March, 1909. (P)
Assistant Manager, Kingston Gas & Electric Company, 611 Broadway, Kingston, New York.

Sucher, Theodore Richard, September, 1914.
Superintendent of Mains and Services, New Haven Gas Light Company, 80 Crown Street, New Haven, Connecticut.

Suchomel, Thomas, October, 1906.
Superintendent of Gas Works, Cedar Rapids Gas Light Company, 501 6th Avenue, Cedar Rapids, Iowa.

Summers, George, October, 1906. (P)
Chief Engineer, Citizens Gas Company, 645 East 21st Street, Indianapolis, Indiana.

Sumner, Arthur William, March, 1913.
Gas Engineer and Manager, Grays & Tilbury Gas Company, Dorincourt, Stifford, Grays, Essex, England.

Swan, Geo. J., September, 1907. (P)
Superintendent, Consumers Light, Heat & Power Company, 214 East First Street, Topeka, Kansas.

Sweetman, W. D., October, 1906. (P)
Superintendent, Division Street Station, Peoples Gas Light & Coke Company, 1241 West Division Street, Chicago, Illinois.

Tait, Frank M., October, 1906.
President, The Dayton (Ohio) Power & Light Company, 54 Wall Street, New York, New York.

Talbot, Frank, October, 1906. (P)
Superintendent and Treasurer, City of Danville Water & Light Department, Main Street, Danville, Virginia.

Taussig, J. Hawley, October, 1906. (P)
Engineer of Design, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Taylor, Allyn Chandler, September, 1908.
Engineering Assistant, Allentown Gas Company, 516 Hamilton Street, Allentown, Pennsylvania.

Taylor, Edward Hamilton, September, 1916.
Fuel and Gas Engineer, 645 Rookery Building, Chicago, Illinois.

Taylor, Horace Greeley, March, 1914.
Assistant Engineer to Agent, Lawrence Gas Company, 370 Essex Street, Lawrence, Massachusetts.

Taylor, John Byron, September, 1907.
Treasurer, Watertown Gas Light Company, Watertown, New York.

Taylor, Wm. H., September, 1908. (P)
Manager, Omaha Gas Company, 1509 Howard Street, Omaha, Nebraska.

Tenney, Albert Ball, September, 1907.
Vice-President, Malden & Melrose Gas Light Company, 207 Devonshire Street, Boston, Massachusetts.

Tenney, Charles H., October, 1906.
President, Springfield Gas Company, Springfield, Massachusetts.

Terradell, William Francis, September, 1916.
Superintendent of Distribution, Public Service Gas Company, 111 Richmond Street, Plainfield, New Jersey.

Terry, H. Warren, Jr., October, 1906.
Assistant Chief Chemist, Consolidated Gas Company, 10 Hamilton Avenue, Ossining, New York.

Thomas, Carl C., March, 1912.
Professor of Mechanical Engineering, Johns Hopkins University, 114 Roland Avenue, Baltimore, Maryland.

Thomas, Charles G. M., October, 1906.
President, New York & Queens Electric Light & Power Company, 444 Jackson Avenue, Long Island City, New York.

Thomas, Nathaniel W., September, 1912.
Chief Inspector, Bureau of Gas, 332 City Hall, Philadelphia, Pennsylvania.

Thompson, Clarence E., September, 1912.
President, Wallingford Gas Light Company, 810 Chapel Street, New Haven, Connecticut.

Thompson, Paul, October, 1906.
Fifth Vice-President, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Thomson, George W., October, 1906.
Assistant Manager, Philadelphia Suburban Gas & Electric Company, 6th and Welsh Streets, Chester, Pennsylvania.

Thomson, W. H., Jr., September, 1908.
General Manager, 4124a McPherson Avenue, St. Louis, Missouri.

Thorn, Fredk. Godfrey, Jr., October, 1906.
Engineer of Construction, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

THUMAN, FREDERIC, September, 1907.
Chief Engineer and General Manager, Humphreys & Glasgow, 38 Victoria Street, London, S. W., England.

THWING, ORRELL O., October, 1906. (P)
Chief Engineer, Western Gas Construction Company, 3002 Thompson Avenue, Fort Wayne, Indiana.

TINCHER, T. SYMMES, September, 1911.
Superintendent East Station, Washington Gas Light Company, 4222 New Hampshire Avenue, N. W., Washington, D. C.

TIPPY, B. O., October, 1906.
Consulting Engineer, 710 Union Trust Building, Detroit, Michigan.

TIPPY, CHARLES W., October, 1906.
General Manager, Commonwealth Power Company, 214 West Main Street, Jackson, Michigan.

TITZEL, R. JOHN, September, 1911.
Gas Engineer, United Gas & Electric Engineering Corporation, 2100 First Avenue, Birmingham, Alabama.

TOBEY, FRANKLIN, JR., October, 1906.
Manager, Kingston Gas & Electric Company, 611 Broadway, Kingston, New York.

TOLMAN, WILLIAM N., October, 1906.
Constructing Engineer, 261 State Street, Hackensack, New Jersey.

TOWNSEND, ALFRED FREEMAN, September, 1913.
Manager, Beaumont Electric Light & Power Company, Beaumont, Texas.

TOSSELL, ALBERT L., September, 1916. (P)
Superintendent Application Department, Peoples Gas Light & Coke Company, 1635 Peoples Gas Building, Chicago, Illinois.

TRAVER, ALVA F., October, 1906. (P)
Superintendent, Gas Department, Denver Gas & Electric Company, 900 15th Street, Denver, Colorado.

TRAVIS, FRANK M., October, 1906.
Treasurer, Torrington Electric Light & Gas Company, 58 Church Street, Torrington, Connecticut.

TREADWAY, ALFRED ALANSON, September, 1914. (P)
Assistant Engineer, Detroit City Gas Company, 146 Glynn Court, Detroit, Michigan.

Treleaven, L. G., September, 1907.
Receiver, Consumers Light, Heat & Power Company, 824 Kansas Avenue, Topeka, Kansas.

Trimble, James, September, 1914.
Vice-President and Manager, Sault Ste. Marie Gas & Electric Company, 419 Ashmun Street, Sault Ste. Marie, Michigan.

Tucker, C. A., October, 1906.
Assistant Treasurer, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

Tudbury, John Leslie, September, 1914.
Manager, Salem Gas Light Company, 247 Essex Street, Salem, Massachusetts.

Tull, Lucien P. F., October, 1906.
Accountant, New Amsterdam Gas Company, 130 East 15th Street, New York, New York.

Turner, Alfred E., September, 1912.
Assistant General Superintendent of Meters, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Tuttle, W. B., October, 1906.
Vice-President and General Manager, San Antonio Gas & Electric Company, 305 East Houston Street, San Antonio, Texas.

Tutwiler, Carrington Cabell, October, 1906. (P)
Consulting Chemist, 1630 Real Estate Trust Building, Philadelphia, Pennsylvania.

Uhlig, Edward C., March, 1911.
Chief Chemist, Brooklyn Union Gas Company, 191 St. James Place, Brooklyn, New York.

Underhill, Henry L., September, 1908. (P)
Assistant Engineer of Manufacture, Consolidated Gas Company, Residence, 200 West 54th Street, New York, New York.

Underwood, Charles E., March, 1914.
General Superintendent, Allegheny By-Product Coke Company, McKeesport, Pennsylvania.

Vance, Champ Shepherd, September, 1910.
Third Vice-President, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

Vance, Samuel Miller, September, 1916.
General Manager and Treasurer, Bristol Gas & Electric Company, 615 State Street, Bristol, Virginia-Tennessee.

VAN NESS, L. G., October, 1906. (P)
Vice-President and General Manager, The Merchants Power Company, 48 North Second Street, Memphis, Tennessee.

VANDER WILLIGEN, T. A., September, 1908.
Continental Representative of Humphreys & Glasgow, Ltd., 36 Victoria Street, London, S. W., England.

VILVEN, FRED W., September, 1916. (P)
District Manager, Western United Gas & Electric Company, Batavia, Illinois.

VINCENT, G. I., October, 1906. (P)
Engineer, Syracuse Lighting Company, Syracuse, New York.

VON GEMMINGEN-HORNBERG, WM. G., September, 1916.
Superintendent, Manufacturing Department, Brockton Gas Light Company, 46 Centre Street, Brockton, Massachusetts.

VONMAUR, JACOB D., October, 1906. (P)
Superintendent of Distribution, Laclede Gas Light Company, 11th and Olive Streets, St. Louis, Missouri.

VON PHUL, WILLIAM, September, 1912.
Member of firm, Ford, Bacon & Davis, Engineers, 1991 Broadway, San Francisco, California.

VONVITTINGHOFF, HANS, September, 1908.
Secretary to Vice-President, Stone & Webster, 147 Milk Street, Boston, Massachusetts.

VOORHEES, ANDREW JOHN, March, 1913.
Secretary to President, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

WAGNER, FRED H., March, 1907. (P)
Chief Engineer, The Bartlett Hayward Company, Rogers Avenue and Pimlico Road, Station E, Baltimore, Maryland.

WAINWRIGHT, ARTHUR V., October, 1906.
General Manager, American Public Service Company, Abilene, Texas.

WALDRON, CHARLES, JR., September, 1908.
Central Hudson Gas & Electric Company, 50 Market Street, Poughkeepsie, New York.

WALKER, EDWIN M., October, 1906.
General Manager, Union Electric Company, Dubuque, Iowa.

WALKER, M. T., October, 1906.
Manager, Beaumont Gas Light Company, Beaumont, Texas.

WALLACE, CYLON WILSON, September, 1916.
General Manager, Niagara Light, Heat & Power Company, 16 Young Street, Tonawanda, New York.

WALLACE, R. A., October, 1906.
Superintendent, Gas Division, Quebec Railway, Light, Heat & Power Company, 10 Palace Hill, Quebec, Canada.

WALLACE, ROSS STRAWN, March, 1913.
Second Vice-President and General Manager, Central Illinois Light Company, 316 South Jefferson Avenue, Peoria, Illinois.

WALLACE, SCOTT HENRY, September, 1912.
Assistant General Manager, St. Louis County Gas Company, Lockwood and McClure Avenues, Webster Groves, Missouri.

WALTER, E. P., September, 1913.
Engineer, 508 Cedar Lane, Swarthmore, Pennsylvania.

WALTERS, BENJ. S., October, 1906.
Vice-President, Northern Indiana Gas & Electric Company, 571 Hohman Street, Hammond, Indiana.

WARING, CLARENCE H., March, 1914.
Superintendent, Wyandotte County Gas Company, 600 Minnesota Avenue, Kansas City, Kansas.

WARING, GEORGE H., October, 1906. (P)
Vice-President, Charleston Consolidated Railway & Lighting Company, 141 Meeting Street, Charleston, South Carolina.

WARNER, GEORGE H., October, 1906.
Vice-President, William M. Crane Company, 16 West 32d Street, New York, New York.

WARNICK, JOHN H., September, 1908. (P)
Assistant to General Superintendent, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

WATERBURY, HERBERT JESSUP, September, 1910.
Manager, Marquette Gas Light Company, Marquette, Michigan.

WATERS, JOHN A., October, 1906. (P)
Assistant Superintendent, Gas Department, The Stamford Gas & Electric Company, 805 Atlantic Street, Stamford, Connecticut.

WAY, ALBERT L., September, 1916.
Superintendent of Distribution, Public Service Gas Company, South Amboy, New Jersey.

Way, Alexander B., September, 1911. (P)
Chief Chemist, New England Gas & Coke Company, Everett, Masachusetts.

Webber, Paul B., March, 1914.
Treasurer, Athol Gas & Electric Company, 78 Devonshire Street, Boston, Massachusetts.

Weber, F. C., September, 1910. (P)
Gas Engineer, H. L. Doherty & Company, 60 Wall Street, New York, New York.

Weber, T. G., March, 1914. (P)
Assistant Superintendent, Central Union Gas Company, 905 East 138th Street, New York, New York.

Weber, Theo. J., September, 1908. (P)
Consulting Engineer, United Light & Railway Company, 823 Michigan Trust Building, Grand Rapids, Michigan.

Weeks, Harvey E., September, 1916. (P)
District Manager, Western United Gas & Electric Company, Joliet, Illinois.

Wehnert, H. C., September, 1913. (P)
Superintendent, Station A, Laclede Gas Light Company, Laclede Gas Building, 11th and Olive Streets, St. Louis, Missouri.

Wehrle, George, September, 1916.
Assistant Superintendent, Gas Department, Denver Gas & Electric Company, 900 15th Street, Denver, Colorado.

Weinmeister, Carl J., March, 1914.
Superintendent of Mains, Atlanta Gas Light Company, Electric and Gas Building, Atlanta, Georgia.

Weisser, Frank Ludwig, March, 1916. (P)
Superintendent, Gas Department, San Antonio Gas & Electric Company, 305 East Houston Street, San Antonio, Texas.

Welch, John S., October, 1906.
Manager, Industrial Division, The United Gas Improvement Company, 1035 Market Street, Philadelphia, Pennsylvania.

Welsh, William J., October, 1906. (P)
President and Manager, New York & Richmond Gas Company, 691 Bay Street, Stapleton, Staten Island, New York.

Wepfer, William Mackness, March, 1914.
Chief Draftsman, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

WERNER, LOUIS H., September, 1910.
Secretary, Central Union Gas Company, 519 Courtlandt Avenue, New York, New York.

WESTCOTT, JOHN TOWNSEND, October, 1906.
Consulting Engineer, 11 Strawberry Hill Road, Twickenham, London, England.

WESTON, EDGAR C., September, 1912.
Superintendent, Gas Light Company, 240 Court Street, Middletown, Connecticut.

WETLAUFER, ERVIN HUDSON, September, 1916.
Assistant Engineer, Henry I. Lea, Consulting Gas Engineer, 1352 Peoples Gas Building, Chicago, Illinois.

WHEELER, FRED B., October, 1906.
Gas, Electrical and Chemical Engineer, Stepney Depot, Connecticut.

WHEELER, HUGH FLOWER, September, 1916.
General Manager, Hattiesburg Traction Company, Hattiesburg, Mississippi.

WHIPPLE, HENRY S., October, 1906. (P)
Manager, Rockford Gas Light & Coke Company, 201 Mulberry Street, Rockford, Illinois.

WHIPPLE, ROBERT H., March, 1913.
Engineering Department, American Gas Company, West Washington Square, Philadelphia, Pennsylvania.

WHITCOMB, H. D., October, 1906.
Vice-President and General Manager, Public Service Gas Company, 80 Park Place, Newark, New Jersey.

WHITE, ALFRED H., September, 1909. (P)
Professor of Chemical Engineering, University of Michigan, 715 Church Street, Ann Arbor, Michigan.

WHITE, HOWARD EDMUND, March, 1915.
Assistant Superintendent, New Haven Gas Light Company, 80 Crown Street, New Haven, Connecticut.

WHITE, JOHN T., March, 1911.
Superintendent of Street Main Department, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

WHITE, WILLIAM MORSE, March, 1912.
Superintendent, Coke Oven Dept., Philadelphia Suburban Gas & Electric Company, 2503 West 4th Street, Chester, Pennsylvania.

WHITELEY, BENJAMIN, September, 1908.
Assistant Treasurer, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

WHITNEY, ROY FOXWELL, March, 1910.
Manager and Treasurer, Peoples Gas & Electric Company, 70 East First Street, Oswego, New York.

WHITTAKER, ALAN DEAN, October, 1910.
Superintendent of Works, Atlanta Gas Light Company, 38 Thurmond Street, Atlanta, Georgia.

WHITTED, THOMAS B., September, 1916.
Mechanical Engineer, 1100 Realty Building, Charlotte, North Carolina.

WHITTON, W. H., October, 1906.
Secretary and Treasurer, Laclede Gas Light Company, 11th and Olive Streets, St. Louis, Missouri.

WHITWELL, L. M., March, 1909. (P)
General Superintendent, Semet-Solvay Company, Syracuse, New York.

WHITWELL, SANFORD N., September, 1912. (P)
General Auditor, Washington Gas Light Company, 413 10th Street, N. W., Washington, District of Columbia.

WHYSALL, GEORGE, October, 1906.
Consulting Engineer, Hamilton (Ontario) Gas Light Company, Marion, Ohio.

WILBUR, MONROE ELMER, March, 1916.
Auditor, Boston Consolidated Gas Company, 111 Devonshire Street, Boston, Massachusetts.

WILDE, CHARLES, March, 1908. (P)
Engineer of Mains, Philadelphia Suburban Gas & Electric Company, 6th and Welsh Streets, Chester, Pennsylvania.

WILDER, STUART, September, 1912.
Vice-President, Northern Westchester Lighting Company, First Avenue and First Street, Mt. Vernon, New York.

WILEY, LYMAN A., March, 1910. (P)
Secretary, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

WILKE, ARNO C., March, 1909. (P)
Chemist, Milwaukee Gas Light Company, 25th Street and St. Paul Avenue, Milwaukee, Wisconsin.

WILKINSON, A. L., October, 1906.
Treasurer, National Gas, Electric Light & Power Company, 1714 Ford Building, Detroit, Michigan.

WILLARD, FRED A., March, 1907.
Manager, McAlester Gas & Coke Company, McAlester, Oklahoma.

WILLETT, WILLIAM MARBLE, September, 1916.
Assistant General Manager, Western United Gas & Electric Company, 341 Spruce Street, Aurora, Illinois.

WILLIAMS, EDWIN H., October, 1906.
Manager, The Waterbury Gas Light Company, Centre and Leavenworth Streets, Waterbury, Connecticut.

WILLIAMS, HERBERT G.,. October, 1906.
Superintendent, Gas Department, St. Cloud Public Service Company, St. Cloud, Minnesota.

WILLIAMS, LUTHER S., October, 1906. (P)
Manager, Harrisburg Gas Company, 1523 North 2d Street, Harrisburg, Pennsylvania.

WILLIAMSON, JOHN, October, 1906. (P)
First Vice-President and Consulting Engineer, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

WILLIEN, LEON JOHN, JR., September, 1916.
Chemical Engineer, Charles H. Tenney & Company, 201 Devonshire Street, Boston, Massachusetts.

WILLIS, CHARLES MOORE, March, 1907.
Manager, Peoples Gas & Electric Company, Chillicothe, Missouri.

WILLS, JOHN VALENTINE, September, 1911. (P)
Superintendent of Gas Works, Northern Indiana Gas & Electric Company, 1011 Old Fort Street, Fort Wayne, Indiana.

WILSON, H. H., March, 1907.
Manager, Wausau Gas Company, 401 Fourth Street, Wausau, Wisconsin.

WILSON, RODNEY M., September, 1912.
Chief Draughtsman, Department of Mains and Services, Consolidated Gas Co., 130 East 15th Street, New York, New York.

Wilson, W. A., October, 1906.
Superintendent, Rockford Gas Light & Coke Company, Rockford, Illinois.

Wing, John Franklin, March, 1908. (P)
Superintendent, Everett Station, Boston Consolidated Gas Company, Everett, Massachusetts.

Witherby, Edwin C., October, 1906.
Vice-President, Semet-Solvay Company, Syracuse, New York.

Witherby, Edwin E., October, 1906. (P)
New England Representative, Gas Machinery Company, Boston, Massachusetts; East Harpswell, Maine.

Wolff, Samuel E., October, 1906.
Care of Hodenpyl, Hardy & Company, 14 Wall Street, New York, New York.

Wood, William Austin, October, 1906.
First Vice-President and Engineer-in-Chief, Boston Consolidated Gas Company, 24 West Street, Boston, Massachusetts.

Wood, William Musgrave, September, 1907.
Department of Second Vice-President, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Woodall, George Herbert, September, 1908.
General Manager, Brooklyn Borough Gas Company, Surf Avenue and West 12th Street, Coney Island, New York.

Woods, George E., October, 1906. (P)
Assistant Chief Engineer, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Woolfolk, William Gordon, September, 1916.
Chicago Manager, Sanderson & Porter, Engineers, 72 West Adams Street, Chicago, Illinois.

Workman, D. M., September, 1916. (P)
District Manager, Western United Gas & Electric Company, Woodstock, Illinois

Wortendyke, I. F., October, 1906. (P)
Superintendent, New Gas Light Company, 7 North Main Street, Janesville, Wisconsin.

Worthing, Leigh E., September, 1911.
Experimental Engineer, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

WRIGHT, W. H., October, 1906. (P)
Engineer, Citizens Gas Company of Indianapolis, 2734 North Pennsylvania Street, Indianapolis, Indiana.

WRIGHTINGTON, EDGAR N., October, 1906.
Secretary and Manager, Commercial Department, Boston Consolidated Gas Company, 24 West Street, Boston, Massachusetts.

WUEST, HENRY ANDREW, September, 1908.
Chief Clerk, Brooklyn Union Gas Company, Foot North 12th Street, Brooklyn, New York.

WYANT, ROBERT E., October, 1906.
Engineer, New Haven Gas Light Company, 80 Crown Street, New Haven, Connecticut.

WYER, SAMUEL S., September, 1915. (P)
Consulting Engineer, Huntington Bank Building, Columbus, Ohio.

WYMAN, WALTER S., September, 1912.
Treasurer and General Manager, Central Maine Power Company, 311 Water Street, Augusta, Maine.

YOUNG, ALFRED W., October, 1906.
General Manager, Knoxville Gas Company, Knoxville, Tennessee.

YOUNG, EDWIN S., March, 1915.
Assistant Secretary, New York Mutual Gas Light Company, 142 East 15th Street, New York, New York.

YOUNG, JOHN T., March, 1907. (P)
General Manager, Grand Rapids Gas Light Company, Ottawa and Pearl Streets, Grand Rapids, Michigan.

YOUNG, PERCY S., October, 1906.
Comptroller, Public Service Gas Company, 80 Park Place, Newark, New Jersey.

YOUNG, PETER, October, 1906.
Gas Department, Watertown Light & Power Company, 135 Flower Street, Watertown, New York.

YOUNG, R. R., October, 1906.
New Business Agent, Public Service Gas Company, 80 Park Place, Newark, New Jersey.

YOUNG, ROBERT W. H., March, 1911. (P)
Superintendent, Consolidated Gas Company, 3300 Second Avenue, Pittsburgh, Pennsylvania.

ZEEK, CHARLES F., October, 1906. (P)
Superintendent, Pensacola Gas Company, 27 East Garden Street, Pensacola, Florida.

Total Active Members.....1,137

ASSOCIATE MEMBERS.

AHLBRANDT, G. F., March, 1913.
Metallurgical Engineer, American Rolling Mill Company, Middletown, Ohio.

AIKIN, HUGH CARLON, October, 1906.
Eastern Sales Manager, Eclipse Gas Stove Company, 1016 Madison Street, Chester, Pennsylvania.

ANNETT, EDWARD BURDETT, September, 1911.
Inspector of Gas, Public Utility Commission, State of New Jersey, 790 Broad Street, Newark, New Jersey.

ASENDORF, CARL F., October, 1906. (P)
Representative, American Meter Company, 38 South Jefferson Street, Chicago, Illinois.

ATWATER, C. G., October, 1906. (P)
Engineer, American Coal Products Company, 17 Battery Place, New York, New York.

AZOY, ANASTASIO C. M., October, 1906.
Manager, Berwind-White Coal Mining Company, 1 Broadway, New York, New York.

BABCOCK, CHARLES B., September, 1915.
Manager, General Gas Light Company, 768 Mission Street, San Francisco, California.

BALDWIN, ABRAM T., September, 1912.
President and General Manager, Precision Instrument Company, 102 Randolph Street, Detroit, Michigan.

BALZ, GEORGE ADAM, March, 1911. (P)
Manager, Didier-March Company, Gas Engineers, Perth Amboy, New Jersey.

BARBOUR, WILLIAM TEFFT, October, 1906.
President, Detroit Stove Works, 1320 Jefferson Avenue, Detroit, Michigan.

BARNES, WILLIAM WALLACE, March, 1914. (P)
Manufacturer, Lighting Fixtures, Bayley & Sons, Inc., 101 Park Avenue, New York, New York.

Beaumont, Robert Herbert, September, 1915. (P)
President, R. H. Beaumont Company, 1043 Drexel Building, Philadelphia, Pennsylvania.

Behrend, F., March, 1915.
Importer of Purifying Material, Fire Brick, etc., 54 Front Street, New York, New York.

Berry, F. K., October, 1906.
President, A. B. Stove Company, Battle Creek, Michigan.

Bigelow, Lucius Seymour, October, 1906. (P)
President and Editor, *The Gas Industry*, 64 Pearl Street, Buffalo, New York.

Bingham, R. W., October, 1906. (P)
Contract Agent, Welsbach Street Lighting Company of America, Peoples Gas Building, Chicago, Illinois.

Boothe, George P., October, 1906.
Superintendent, S. R. Dresser Manufacturing Company, Boylston Street, Bradford, Pennsylvania.

Braun, Charles A., March, 1914. (P)
Sales Agent, Stonega Coke & Coal Company, 629 Real Estate Trust Building, Philadelphia, Pennsylvania.

Brill, Alfred P., October, 1906. (P)
General Manager, Ruud Manufacturing Company, 29th and Smallman Streets, Pittsburgh, Pennsylvania.

Brown, William Laird, September, 1912. (P)
Assistant Manager, Helme & McIlhenny, 1339 Cherry Street, Philadelphia, Pennsylvania.

Bunnell, Sterling H., October, 1906. (P)
Chief Engineer, R. Martens & Company, Inc., 24 State Street, New York, New York.

Caldwell, Jas. Henry, September, 1909.
President, Ludlow Valve Company, Troy, New York.

Carlisle, Edgar G., September, 1914.
Secretary, Blair Parke Coal & Coke Company, 1618 Real Estate Trust Building, Philadelphia, Pennsylvania.

Carpenter, Frank, March, 1911.
Special Representative, Welsbach Gas Lamp Company, 392 Canal Street, New York, New York.

Carpenter, H. A., October, 1906. (P)
Sewickley, Pennsylvania.

Cartwright, Henry R., October, 1906.
Manager, Philadelphia Factory, American Meter Company, 3112 North 17th Street, Philadelphia, Pennsylvania.

Carty, Andrew Jackson, March, 1915.
Wholesale Coal, 711 Stephen Girard Building, Philadelphia, Pennsylvania.

Cavenagh, Frank, March, 1911.
General Sales Agent, Pacific Meter Company, 732 Title Insurance Building, Los Angeles, California.

Cavender, John H., September, 1916.
Vice-President, Chicago Retort & Firebrick Company, 208 South La Salle Street, Chicago, Illinois.

Chapin, Edwin S., March, 1908.
Vice-President, Welsbach Gas Lamp Company, 392 Canal Street, New York, New York.

Cheesman, Frank P., October, 1906.
Partner, Cheesman & Elliot, 100 William Street, New York, New York.

Chisholm, Charles T., October, 1906.
Traveling Representative, General Gas Light Company, Kalamazoo, Michigan.

Church, Sumner Rollin, March, 1915. (P)
Manager, Research Department, The Barrett Company, 17 Battery Place, New York, New York.

Clader, William A., March, 1912.
Certified Public Accountant, 1131 Land Title Building, Philadelphia, Pennsylvania.

Claiborne, Chas. H., March, 1909.
General Sales Manager, Union Mining Company, Manufacturers Mount Savage Fire Brick, 1113 Fidelity Bldg., Baltimore, Md.

Clark, Charles J., March, 1911.
Vice-President, Hunter & Dickson Company, 245 Arch Street, Philadelphia, Pennsylvania.

Clark, Robert Keep, March, 1914. (P)
Assistant Manager, George M. Clark & Company Division, 179 North Michigan Avenue, Chicago, Illinois.

Conroy, James P., March, 1913. (P)
Manager, General Gas Light Company, 44 West Broadway, New York, New York.

Cooke, Horace G., September, 1913.
Sales Agent, Connersville Blower Company, 114 Liberty Street, New York, New York.

Corbus, F. G., October, 1906. (P)
Superintendent, Retail Departments, Welsbach, Company, Gloucester City, New Jersey.

Cressler, George H., October, 1906. (P)
Walker & Cressler, First National Bank Building, Chicago, Illinois.

Curfman, Floyd G., September, 1914. (P)
Apartment No. 2, 702 Sheridan Road, Chicago, Illinois.

Daly, David R., October, 1906.
Vice-President and General Manager, J. H. Gautier & Company, Green and Essex Streets, Jersey City, New Jersey.

Davis, William Walley, September, 1916.
Manager, Coke Oven Department, By-Products Coke Corporation, 1501 McCormick Building, Chicago, Illinois.

DeHart, J. S., Jr., October, 1906. (P)
President, Isbell-Porter Company, 46 Bridge Street, Newark, New Jersey.

Dickey, Edmund S., October, 1906.
Manager, Maryland Meter Works, Guilford Avenue and Saratoga Street, Baltimore, Maryland.

Diffenderffer, Charles H., March, 1916.
President, Blair-Parke Coal & Coke Company, Real Estate Trust Building, Philadelphia, Pennsylvania.

Dougherty, Charles, September, 1910.
Air Compressor and Pneumatic Tool Salesman, Ingersoll-Rand Company, 11 Broadway, New York, New York.

Drewson, John, March, 1914. (P)
Superintendent of By-Product Coke Ovens, River Furnace Company, 4002 Dille Avenue, Cleveland, Ohio.

Earnshaw, Warner G., September, 1908.
General Sales Manager, Barnes & Tucker Company, 718 Harrison Building, Philadelphia, Pennsylvania.

Eisenman, F. N., September, 1908.
District Sales Manager, Gulf Refining Company, 185 Devonshire Street, Boston, Massachusetts.

Elmer, Charles Bliss, September, 1913.
Vice-President and Treasurer, General Gas Appliance Company, 103 Park Avenue, New York, New York.

Esau, Ralph, October, 1906.
Manager of Sales, Barrett Manufacturing Company, 1200 Otis Building, Chicago, Illinois.

Fairchild, Samuel E., Jr., September, 1912.
President, Cruse-Kemper Company, Ambler, Pennsylvania.

Felix, Otto F., March, 1915.
Secretary and Treasurer, Equitable Meter Company, 422 First Avenue, Pittsburgh, Pennsylvania.

Foersterling, Dr. H., September, 1909.
Second Vice-President, Roessler & Hasslacher Chemical Company, 357 High Street, Perth Amboy, New Jersey.

Fowler, J. Scott, October, 1906.
Treasurer, Deily & Fowler Manufacturing Company, 39 Laurel Street, Philadelphia, Pennsylvania.

Frampton, R. C., March, 1907.
With Baltimore Tube Works, Baltimore, Maryland.

Francisco, Ellsworth, September, 1913. (P)
Inspector of Gas and Gas Meters, City Hall Annex, Newark, New Jersey.

Fritz, H. C., March, 1909.
Manager, Schneider & Trenkamp Division, American Stove Company, Cleveland, Ohio.

Garrison, John J., October, 1906. (P)
Vice-President, Rathbone, Sard & Company, North Ferry Street, Albany, New York.

Goodman, Patrick, October, 1906.
Manager, Safety Gas Main Stopper Company, 257 East 133d Street, New York, New York.

Grant, Albert Weston, Jr., September, 1913.
With H. Koppers Company, 511 Wood Street, Pittsburgh, Pennsylvania.

Gribbel, W. Griffin, September, 1912. (P)
Assistant Manager, J. J. Griffin & Company, 1513 Race Street, Philadelphia, Pennsylvania.

Griffith, David M., September, 1916.
Mechanical and Gas Engineer, Otto Coking Company, 6 Church Street, New York, New York.

Guitteau, William Standart, September, 1914. (P)
Sales Manager, Stacey Brothers Gas Construction Company, Station P, Cincinnati, Ohio.

Hamerstrom, Frederick Nathan, March, 1911.
Commercial Department, Welsbach Company, Ellis and Mercer Streets, Gloucester, New Jersey.

Harper, H. D., October, 1906. (P)
Western Manager, American Meter Company, 1811 Peoples Gas Building, Chicago, Illinois.

Hatton, Richard D., March, 1914. (P)
Vice-President, Laclede-Christy Clay Products Company, 5900 Manchester Avenue, St. Louis, Missouri.

Hayward, E. Bartlett, March, 1907.
President, The Bartlett Hayward Company, Scott and McHenry Streets, Baltimore, Maryland.

Hayward, Sterling F., October, 1906. (P)
Treasurer, Connelly Iron Sponge & Governor Company, 127 Duane Street, New York; 8 Dana Street, Cambridge, Massachusetts.

Henry, William G., October, 1906.
Vice-President, Detroit Stove Works, Detroit, Michigan.

Herbert, Frederick D., September, 1911.
New York Sales Manager, Terry Steam Turbine Company, 90 West Street, New York, New York.

Hibbard, Robert Leonard, September, 1916. (P)
Assistant Manager and Gas Engineer, Riter-Conley Manufacturing Company, Pittsburgh, Pennsylvania.

Hicks, George Cleveland, Jr., October, 1906.
Vice-President and Mechanical Engineer, P. H. & F. M. Roots Company, Box 165, Connersville, Indiana.

Higgins, C. M., October, 1906.
Representative, The Standard Oil Company, 26 Broadway, New York, New York.

Hinman, Walter Hibbard, March, 1911.
With Winchester Repeating Arms, Company, New Haven, Connecticut.

Hobdell, George, October, 1906.
Manager, Phoenix Meter Company, 107 Arch Street, Camden, New Jersey.

Hohmann, August B., September, 1911.
Sales Manager, C. J. Tagliabue Manufacturing Company, Bush Terminal, 32 33d Street, Brooklyn, New York.

Hornsey, John W., September, 1910.
Consulting Engineer, Summit, New Jersey.

Hubbs, John Henry, September, 1908.
Assistant Purchasing Agent, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Hutchinson, William P., March, 1912. (P)
Vice-President and Sales Manager, Sprague Meter Company, 205 Water Street, Bridgeport, Connecticut.

Hyde, Edward P., March, 1910.
Director, Physical Laboratory, National Electric Lamp Association, General Electric Company, Nela Park, Cleveland, Ohio.

Isbell, Charles W., October, 1906.
President, Board of Directors, Isbell-Porter Company, 257 Broadway, New York, New York.

Jewett, Edward Huntting, September, 1914.
President, Jewett, Bigelow & Brooks, 1109 Penobscot Building, Detroit, Michigan.

Johnston, E. D., October, 1906.
President, P. H. & F. M. Roots Company, Connersville, Indiana.

Kahn, Lazard, October, 1906.
Vice-President, Estate Stove Company, Hamilton, Ohio.

Kellum, Benjamin J., October, 1906. (P)
Manager, Western Department, Welsbach Company, Washington Boulevard and Des Plaines Street, Chicago, Illinois.

Kirchberger, Moritz, September, 1909.
President, Crescent Burner Company, 116 East 27th Street, New York, New York.

Knight, William H., October, 1906.
General Manager, Cleveland Gas Meter Company, 2180 East 65th Street, S. E., Cleveland, Ohio.

Koppers, Henry, October, 1907.
President, H. Koppers Company, First National Bank Building, 511 Wood Street, Pittsburgh, Pennsylvania.

Lamb, F. Karl, September, 1916. (P)
Manager, Lamb Construction Company, Marion, Illinois.

LANPHIER, CHARLES H., September, 1914.
Gas and Meter Inspector, City of Springfield, City Hall, Springfield, Illinois.

LATHROP, F. A., March, 1914. (P)
Sales Agent (Chicago Office), Youngstown (Ohio) Sheet & Tube Company, 332 South Michigan Avenue, Chicago, Illinois.

LAUBER, ALBERT, October, 1906.
Treasurer, Standard Meter & Manufacturing Company, 433 West 42d Street, New York, New York.

LEAKEY, NATHAN G., October, 1906.
Assistant Secretary, Michigan Ammonia Works, Detroit, Michigan.

LEMKE, FRANK ALEXANDER, September, 1916. (P)
General Manager, Humphrey Company, Division of Ruud Manufacturing Company, Kalamazoo, Michigan.

LEMOINE, LOUIS R., September, 1913.
President, United States Cast Iron Pipe & Foundry Company, 1421 Chestnut Street, Philadelphia, Pennsylvania.

LEWARS, CHARLES E., September, 1915.
Acting District Superintendent, Semet-Solvay Company, Steelton, Pennsylvania.

LEWIS, THOMAS L., September, 1913.
Assistant Manager of Sales, A. M. Byers Company, 235 Water Street, Pittsburgh, Pennsylvania.

LITLE, THOMAS J., JR., October, 1906. (P)
Engineer, Cadillac Motor Car Company, Detroit, Michigan.

LOCKWOOD, W. A., October, 1906.
General Salesman, Ringen Stove Company, 414 South Sixth Street, St. Louis, Missouri.

MCBRIDE, RUSSELL SMITH, March, 1916. (P)
Associate Chemist, Bureau of Standards, Washington, District of Columbia.

MCCOY, WILLIAM P., March, 1911.
Commercial Department, Welsbach Company, Gloucester, New Jersey.

MCDONALD, FREDERICK, September, 1909.
Gas Meter Manufacturer, 991 Broadway, Albany, New York.

MCILRAVY, W. N., October, 1906. (P)
Vice-President, Barrett Manufacturing Company, 17 Battery Place, New York, New York.

McKean, Norton, September, 1916.
Assistant Superintendent, Nathaniel Tufts Meter Company, 455 Commercial Street, Boston, Massachusetts.

McKee, William, March, 1914.
Secretary, Chaplin-Fulton Manufacturing Company, 34 Penn Avenue, Pittsburgh, Pennsylvania.

McNary, John B., October, 1906.
Manager and Secretary, Canadian Meter Company, Limited, Hamilton, Ontario, Canada.

Macbeth, Norman, September, 1909.
Illuminating Engineer; Editor, *Lighting Journal*; Room 1324, 461 8th Avenue, New York, New York.

Mackenzie, Kenneth Gerard, March, 1914.
Consulting Chemist, The Texas Company, Bayonne, New Jersey.

Manning, W. E., March, 1914.
Secretary, Youngstown Sheet & Tube Company, Youngstown, Ohio.

Martineau, Frederick Clifford, September, 1914.
Assistant Superintendent, Street Department, Consolidated Gas Company, 111th Street and First Avenue, New York, New York.

Mason, John Ambler, September, 1909. (P)
With the Bartlett Hayward Company, 100 Broadway, New York, New York.

Mason, Sidney, October, 1906.
President, Welsbach Company, Gloucester City, New Jersey.

Melcher, Charles W., October, 1906.
General Manager, Ingersoll-Rand Company of Illinois, Peoples Gas Building, Chicago, Illinois.

Miles, Eugene Carpenter, September, 1916. (P)
Editor, *American Gas Light Journal*, 42 Pine Street, New York, New York.

Millar, P. S., March, 1909.
General Manager, New York Electrical Testing Laboratories, 80th Street and East End Avenue, New York, New York.

Miller, Edwin Francis, September, 1914. (P)
Engineer, Camden Iron Works, Camden, New Jersey.

Miller, Fred A., October, 1906. (P)
President and General Manager, S. R. Dresser Manufacturing Company, Boylston Street, Bradford, Pennsylvania.

Miller, Walter Edward, March, 1916.
Division Engineer, Railroad Commission of Wisconsin, 1719 Madison Street, Madison, Wisconsin.

Mingus, James B., March, 1910.
Sales Agent, Penn Gas Coal Company, 222 South Third Street, Philadelphia, Pennsylvania.

Mordue, Thomas N., October, 1906.
Coal Merchant, 817 Peoples Gas Building, Chicago, Illinois.

Mouser, Otis, March, 1914.
Sales Manager, Stonega Coke & Coal Company, Big Stone Gap, Virginia.

Mueller, Robert, October, 1906.
Secretary, H. Mueller Manufacturing Company, Decatur, Illinois.

Newbold, E. S., March, 1909.
President, American Street Lighting Company, 831 Greenmount Avenue, Baltimore, Maryland.

Nibecker, Karl, September, 1915.
Steam Engineer, Youngstown Sheet & Tube Company, Mulberry and Spruce Avenue, N. W., Cleveland, Ohio.

Nicholls, Carroll B., October, 1906. (P)
General Sales Agent, Westmoreland Coal Company, 224 South Third Street, Philadelphia, Pennsylvania.

Norton, Arthur E., October, 1906. (P)
Superintendent, Nathaniel Tufts Meter Company, 455 Commercial Street, Boston, Massachusetts.

Norton, Harry A., October, 1906. (P)
President and Manager, Nathaniel Tufts Meter Company, 455 Commercial Street, Boston, Massachusetts.

Nutty, G. R., October, 1906.
General Sales Manager, Gulf Refining Company, Frick Building Annex, Pittsburgh, Pennsylvania.

Osius, George, October, 1906.
Secretary and Treasurer, Michigan Ammonia Works, Detroit, Michigan.

Page, Edward, September, 1908.
Vice-President, New England Coal & Coke Company, 111 Devonshire Street, Boston, Massachusetts.

Papworth, Harry M., September, 1913.
Salesman and Eastern Manager, P. H. & F. M. Roots Company, 120 Liberty Street, New York, New York.

Parish, William H., March, 1913. (P)
Sales Engineer, Westmoreland Coal Company, 224 South 3rd Street, Philadelphia, Pennsylvania.

Parker, George W., October, 1906. (P)
Vice-President and General Manager, Russell Engineering Company, International Life Building, St. Louis, Missouri.

Parker, John F., September, 1910. (P)
Western Sales Manager, Eclipse Gas Stove Company, Rockford, Illinois.

Patterson, Alfred R., September, 1912.
Auditor, Stone & Webster Management Association, 147 Milk Street, Boston, Massachusetts.

Pattison, Melvin, October, 1906. (P)
General Manager of Sales, Brown Hoisting Machinery Company, 4403 St. Clair Avenue, Cleveland, Ohio.

Payne, F. H., October, 1906.
Manager, Metric Metal Works, 10th and Payne Streets, Erie, Pennsylvania.

Peck, Harry G., September, 1913.
Sales Manager, Lovekin Water Heater Company, 39 Laurel Street, Philadelphia, Pennsylvania.

Peffly, Irvin W., September, 1908. (P)
Eastern Sales Manager, George M. Clark Company, Division American Stove Company, 1493 Broadway, New York, New York.

Penfield, H. P., March, 1914.
Sales Manager, Ball Engine Company, 1001 Commercial Trust Building, Philadelphia, Pennsylvania.

Perkins, Rowan P., September, 1907.
Consulting Engineer, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Perry, A. T., October, 1906.
Vice-President, The Barrett Company, 1317 Illuminating Building, Cleveland, Ohio.

Phillips, L. R., March, 1907.
Care of National Tube Company, Room 1114, 208 South LaSalle Street, Chicago, Illinois.

Piser, Theo. H., October, 1906.
Manager, Welsbach Company of New England, 16 Oliver Street, Boston, Massachusetts.

Plucker, Howard W., September, 1910.
Salesman, with I. A. Sheppard & Company, Erie Avenue and Sepviva Street, Philadelphia, Pennsylvania.

Porter, Horace C., September, 1916. (P)
Chemical Engineer, H. Koppers Company, 511 Wood Street, Pittsburgh, Pennsylvania.

Prendergast, Daniel J., October, 1906.
General Superintendent, Welsbach Street Lighting Company of America, 318 West 42d Street, New York, New York.

Price, W. W., October, 1906.
President, The Dayton Pipe Coupling Company, Edmund and Michigan Avenues, Dayton, Ohio.

Rancke, Louis N., October, 1906.
Consulting Engineer and Chemist, Lonaconing, Maryland.

Reeves, William, October, 1906.
President, The Reeves Manufacturing Company, Milford, Connecticut.

Reichhelm, Paul F., September, 1908.
Secretary, American Gas Furnace Company, 24 John Street, New York, New York.

Reinhardt, G. A., March, 1914. (P)
Metallurgist, Youngstown Sheet & Tube Company, Youngstown, Ohio.

Reynolds, M. G., October, 1906. (P)
General Manager, Reynolds Gas Regulator Company, 1019 Delaware Street, Anderson, Indiana.

Richardson, Charles Germane, September, 1914. (P)
Sales Engineer, Builders Iron Foundry, 9 Codding Street, Providence, Rhode Island.

Roberts, Clarence V., October, 1906.
President, Roberts & Mander Stove Company, 11th Street and Washington Avenue, Philadelphia, Pennsylvania.

Robertson, Lawrence B., March, 1915.
Superintendent of Coke Oven Department, Maryland Steel Company, Post Office Box 88, Sparrows Point, Maryland.

Rodgers, Edward H., October, 1906.
President and Treasurer, Standard Meter Company, 3112 North 17th Street, Philadelphia, Pennsylvania.

Rolston, Robert J., March, 1911.
Manager, Welsbach Company, 1008 Filbert Street, Philadelphia, Pennsylvania.

Russell, Norman F. S., September, 1916.
General Sales Manager, United States Cast Iron Pipe and Foundry Company, 1421 Chestnut Street, Philadelphia, Pennsylvania.

Rust, Robert Ripley, March, 1910.
Superintendent of Foundries, Central Foundry Company, 90 West Street, New York, New York.

Ruud, Edwin, September, 1907.
Manufacturer, Ruud Manufacturing Company, Pittsburgh, Pennsylvania.

Salt, Thomas V., September, 1910.
Vice-President and General Manager, Allegheny By-Products Coke Company, 5547 Bartlett Street, Pittsburgh, Pennsylvania.

Sanders, Barney H., September, 1912.
President and General Manager, American Foundry & Manufacturing Company, St. Louis, Missouri.

Sard, Russell E., September, 1909. (P)
Vice-President and General Manager, Rathbone, Sard & Company, Albany, New York.

Sayer, Eugene Y., October, 1906. (P)
Vice-President and General Manager, Improved Equipment Company, 60 Wall Street, New York, New York.

Schall, Henry D., October, 1906. (P)
Assistant to Vice-President, Detroit Stove Works, 1320 Jefferson Avenue, East, Detroit, Michigan.

Schurz, James R., September, 1907.
General Sales Agent, Camden Coke Company, 755 Broad Street, Newark, New Jersey.

Seaver, Kenneth, September, 1913.
Chief Engineer, Harbison-Walker Refractories Company, Farmers Bank Building, Pittsburgh, Pennsylvania.

Seeger, Robert, October, 1906. (P)
District Manager, Welsbach Street Lighting Company of America, 704 Laclede Gas Building, St. Louis, Missouri.

Shaw, Arthur E., September, 1914. (P)
President, Welsbach Street Lighting Company of America, 1934 Market Street, Philadelphia, Pennsylvania.

Sheppard, Howard R., September, 1909.
Member of firm of I. A. Sheppard & Company, 1801 North 4th Street, Philadelphia, Pennsylvania.

Smith, T. J., Jr., March, 1911.
10 Madison Avenue, Crafton, Pennsylvania.

Smyser, Albert Ernest, March, 1916.
Engineer of Refractories, H. Koppers Company, 511 Wood Street, Pittsburgh, Pennsylvania.

Speller, Frank N., March, 1907. (P)
Metallurgical Engineer, National Tube Company, Frick Building, Pittsburgh, Pennsylvania.

Sperr, Fredk. Wm., Jr., March, 1915. (P)
Chief Chemist, Coke Oven Department, H. Koppers Company, 413 8th Street, Oakmont, Pennsylvania.

Sperry, Richard Evans, March, 1914.
Superintendent of Construction, Bartlett Hayward Company, 100 Broadway, New York, New York.

Sprague, Henry H., March, 1908.
President, Sprague Meter Company, 205 Water Street, Bridgeport, Connecticut.

Stacey, Andrew J., October, 1906.
Vice-President, The Stacey Bros. Gas Construction Company, Station P, Cincinnati, Ohio.

Stacey, James E., October, 1906.
President, The Stacey Bros. Gas Construction Company, Station P, Cincinnati, Ohio.

Stevens, Chester N., September, 1915. (P)
Assistant to Vice-President, The Barrett Company, 17 Battery Place, New York, New York.

Stites, Townsend, September, 1907.
General Manager, Welsbach Company, Gloucester, New Jersey.

Stone, Thomas W., October, 1906. (P)
Engineer, Western Gas Construction Company, 919 Columbia Avenue, Fort Wayne, Indiana.

Storrs, Aaron Putnam, March, 1908.
President, Storrs Mica Company, Owego, New York.

Storrs, Charles P., October, 1906. (P)
Secretary, Storrs Mica Company, Owego, New York.

Strause, Louis J., March, 1914. (P)
Secretary and Treasurer, Strause Gas Iron Company, 1425 Vine Street, Philadelphia, Pennsylvania.

Sullivan, Edward J., March, 1908.
Firm of Sullivan Brothers, 45 Main Street, Flushing, Long Island, New York.

Sullivan, William H., March, 1908.
Firm of Sullivan Brothers, 45 Main Street, Flushing, Long Island, New York.

Taplin, Frank E., October, 1906.
President, Cleveland & Western Coal Company, Leader-News Building, Cleveland, Ohio.

Tatman, J. S., March, 1911. (P)
With Connersville Blower Company, Connersville, Indiana.

Thompson, Robert John, September, 1914.
Manager, Welsbach Company, 863 Mission Street, San Francisco, California.

Timm, Charles F., March, 1911.
Salesman, Wm. M. Crane & Company, 16 West 32d Street, New York City; 46 Point Street, Yonkers, New York.

Tripp, Frank Foster, September, 1913.
Treasurer and General Manager, Lighting Supply Company, 64 Warren Street, Roxbury, Massachusetts.

Tufts, Bowen, September, 1912.
Director, various gas companies, 78 Devonshire Street, Boston, Massachusetts.

Ummach, Charles E., September, 1916. (P)
President, R. Williamson & Company, Washington and Jefferson Streets, Chicago, Illinois.

Unger, John Samuel, March, 1914. (P)
Mechanical and Chemical Engineer (Builder of the Unger Ammonia Still), 3344 Broadway, Chicago, Illinois.

Van Winkle, Walter H., September, 1913.
Vice-President, Water Works Equipment Company, 50 Church Street, New York, New York.

Wardell, Chas. W., September, 1909. (P)
Illuminating Engineer, Welsbach Company, Gloucester, New Jersey.

Warren, Henry J., October, 1906.
President, Stamford Gas Stove Company, Box 388, Stamford, Connecticut.

Weber, Hans F., March, 1906.
Operating Engineer, Didier-March Company, Post Office Box 327, Perth Amboy, New Jersey.

Wehner, Robert K., October, 1906.
Treasurer, Isbell-Porter Company, Bridge and Ogden Streets, Newark, New Jersey.

Weller, William W., September, 1913.
Manager of Sales, A. M. Byers Company, 235 Water Street, Pittsburgh, Pennsylvania.

Wells, Fred K., October, 1906.
Manager, Pittsburgh Water Heater Company of Massachusetts, 69 Broad Street, Boston, Massachusetts.

Wentz, Daniel B., March, 1914.
President, Stonega Coke & Coal Company (Virginia), 1727 Land Title Building, Philadelphia, Pennsylvania.

Westermaier, Francis Victor, October, 1906. (P)
Engineer, Welsbach Street Lighting Company of America, 1934 Market Street, Philadelphia, Pennsylvania.

Wharton, Henry, October, 1906. (P)
Chestnut Hill Station, Philadelphia, Pennsylvania.

Whetstone, Walter, September, 1914.
President, Whetstone & Company, Inc., 911 Filbert Street, Philadelphia, Pennsylvania.

Wickham, Leigh, October, 1906. (P)
General Sales Manager, Parker-Russell Mining & Manufacturing Company, 603 Laclede Gas Building, St. Louis, Missouri.

Willson, S. Tully, September, 1916.
General Manager, Improved Appliance Company, 455 Kent Avenue, Brooklyn, New York.

Wilputte, Louis, March, 1913.
Vice-President and General Manager, Otto Coking Company, 6 Church Street, New York, New York.

Wilson, Edwards F., October, 1906. (P)
Chief Chemist, Westmoreland Coal Company, Irwin, Pennsylvania.

Wilson, John Crosier, September, 1911. (P)
Engineer, Thomas Meter Dept., Cutler-Hammer Manufacturing Company, 12th St. and St. Paul Avenue, Milwaukee, Wisconsin.

Weber, Hans F., March, 1916.
Construction Engineer, Didier-March Company, Post Office Box 327, Perth Amboy, New Jersey.

Wood, Edward R., Jr., October, 1906.
Executor, 401 Chestnut Street, Philadelphia, Pennsylvania.

Young, L. B., October, 1906. (P)
General Manager, The Michigan Stove Company, 1022 Jefferson Avenue, East, Detroit, Michigan.

Young, N. A., March, 1909. (P)
Secretary, James Gardner, Jr., Company, Lincoln Street, Bolivar, Pennsylvania.

Youngman, Robert H., September, 1910.
Assistant to President, Harbison-Walker Refractories Company, 1816 Farmers Bank Building, Pittsburgh, Pennsylvania.

Zitzewitz, Hermann, October, 1906. (P)
President, National Machine Works, Sheffield and North Avenues, Chicago, Illinois.

Total Associate Members 220

JUNIOR MEMBERS.

Alburger, Elmer R., September, 1908.
Constructor, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Anderson, Arthur Henry, March, 1916.
Cadet Engineer, St. Paul Gas Light Company, 121 Iglehart Street, St. Paul, Minnesota.

Baker, John Rea, March, 1916.
Engineer, Fall River Gas Works Company, % Y. M. C. A., Fall River, Mass.

Battin, Henry Weston, September, 1916.
Assistant to Superintendent, Public Service Gas Company, 446 Market Street, Newark, New Jersey.

Baty, Frederick, September, 1916.
Assistant Superintendent of Works, Easton Gas & Electric Company, 212 North Front Street, Easton, Pennsylvania.

Baxter, Edw. O., September, 1908.
Chief Clerk, Westchester Lighting Company, 67 North Broadway, Yonkers, New York.

Baylie, William Percival, September, 1913. (P)
Inspector of Accounts, Distribution Department, Philadelphia Gas Works, 24 North 22d Street, Philadelphia, Pennsylvania.

Beebe, Thomas, Russell, September, 1907.
Commercial Engineer, Oxweld Acetylene Company, 4928 Forest Park Boulevard, St. Louis, Missouri.

Bennitt, George E., September, 1913.
Engineer's Assistant, Department of Utilization, Consolidated Gas Company, 220 South Ninth Avenue, Mt. Vernon, New York.

Bertolette, Norman Boone, September, 1914.
Division Engineer, Philadelphia Suburban Gas & Electric Company, Jenkintown, Pennsylvania.

Bond, Frederick Almon, March, 1916.
Cadet Engineer, Philadelphia Suburban Gas & Electric Company, Coke Ovens, Chester, Pennsylvania.

Budde, John Henry, September, 1914.
Secretary to Construction Engineer, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Burnett, Frederick, October, 1906.
Assistant Engineer, Economical Gas Apparatus Construction Company, 165 King Street, East, Toronto, Ontario, Canada.

Butler, Joseph, September, 1914.
Engineer, Gas Department, Syracuse Lighting Company, Mechanic Street, Syracuse, New York.

Byrne, Thomas J., September, 1912.
Superintendent's Assistant, Consolidated Gas Company of New York, 501 East 21st Street, New York, New York.

Call, Almon Eugene, September, 1912. (P)
Assistant Engineer of Tests, Island Creek Coal Sales Company, 511 Plymouth Building, Minneapolis, Minnesota.

Callahan, Cornelius F., September, 1913.
Superintendent of Construction, Nassau & Suffolk Lighting Company, 52 Vancott Avenue, Hempstead, Long Island, New York.

Callahan, John Joseph, March, 1911.
31 Tompkins Street, Stapleton, Staten Island, New York.

Callaway, George Samuel, September, 1912.
Superintendent's Assistant, Equity Works, Brooklyn Union Gas Company, Maspeth and Porter Avenues, Brooklyn, New York.

Canon, Frank Ashton, March, 1914.
Chemist, The United Gas Improvement Company, 6221 Ogontz Avenue, Philadelphia, Pennsylvania.

Carter, Charles Freeman, March, 1913.
Cadet Engineer, Savannah Gas Company, 110 Broughton Street, West, Savannah, Georgia.

Chidsey, Raymond F., September, 1911.
Assistant Manager, Kingston Gas & Electric Company, 611 Broadway, Kingston, New York.

Cloen, Fred, March, 1914.
General Superintendent, Paducah Light & Power Company, 406 Broadway, Paducah, Kentucky.

Coles, Sidney S., September, 1913.
Assistant to Engineer, Westchester Lighting Company, 1st Avenue and 1st Street, Mount Vernon, New York.

Collester, Earl H., March, 1915.
Superintendent, Coke Ovens, La Belle Iron Works, Steubenville, Ohio.

Collier, Edward Carlton, March, 1913.
New Business Manager, Rochester Gas & Fuel Company, Rochester, Indiana.

Colton, Francis, March, 1914.
Assistant to Engineer, Public Service Construction Company, 262 Argyle Road, Brooklyn, New York.

Coombs, Fred S., October, 1906.
Superintendent, Meter Department, Youngstown Consolidated Gas & Electric Company, Post Office Box 58, Youngstown, Ohio.

Cotton, Francis Joseph, March, 1914.
Superintendent's Assistant, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

Cozzens, John Howard, March, 1915.
Superintendent's Assistant, Holder Distribution Dept., Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Crankshaw, J. Ward, March, 1910.
Allentown Gas Company, Allentown, Pennsylvania.

Crouse, William Thomas, March, 1914.
Assistant Superintendent of Stores, United Gas Improvement Co., 19th St. and Allegheny Ave., Philadelphia, Pennsylvania.

Crowell, Hugh Ramsay, September, 1914.
Engineer's Assistant, Consolidated Gas Company of New York, 80 Elizabeth Street, New York, New York.

Crowell, James Kenneth, September, 1908.
Assistant to Engineer, Westchester Lighting Company, North Main Street, Portchester, New York.

Dickey, Philip S., March, 1912.
Foreman, Fitting Shop, Beloit Water, Gas & Electric Company, 429 East Grand Avenue, Beloit, Wisconsin.

Dowley, Edwin, September, 1916.
Inspector, Laclede Gas Light Company, 919-A, South Taylor Avenue, St. Louis, Missouri.

Duncan, Howard William, September, 1912. (P)
32 West William Street, Hammond, Indiana.

Eichengreen, Leon B., March, 1913.
Assistant to General Superintendent, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Ellis, R. L., March, 1913.
Superintendent, Selma Lighting Company, Selma, Alabama.

Felton, John Garrett, March, 1912.
Superintendent, Electric Department, Charleston Consolidated Railway & Lighting Company, Charleston, South Carolina.

Fitzpatrick, Daniel, October, 1906.
Foreman of Works, St. Augustine Gas & Electric Light Company, St. Augustine, Florida.

Ford, Andrew Joseph, September, 1914.
District Draftsman, Consolidated Gas Company of New York, 96 South 11th Street, Newark, New Jersey.

Ford, Charles McCabe, March, 1913.
Chief Clerk and Assistant General Foreman, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Fox, Charles J., October, 1906.
Superintendent of Distribution, Philadelphia Suburban Gas & Electric Company, 867 Main Street, Darby, Pennsylvania.

Galligan, James Edward, March, 1914.
General Foreman of Mains, Westchester Lighting Company, 127 Convent Place, Yonkers, New York.

Galloway, James Wesley, March, 1915.
Consumers Gas Company, 444 Court Street, Reading, Pennsylvania.

Gardner, Ralph Russell, September, 1916.
Engineer's Assistant, Old Colony Gas Company, Weymouth, Massachusetts.

Gellert, Nathan H., March, 1911.
Constructing Gas Engineer, 133 Poplar Avenue, Wayne, Pennsylvania.

Gibbs, Tucker Carrington, March, 1914.
Manager, Gibbs Gas Engine Company, Jacksonville, Florida.

Gibson, James Coe, September, 1912.
Agent, Kansas Distributing Company, Eureka, Kansas.

Gonzalez, Americo Rodriguez, March, 1913.
Havana, Cuba.

Green, Albert, October, 1906.
General Foreman of Fitters, The United Gas Improvement Company, 4251 Romain Street, Philadelphia, Pennsylvania.

Green, J. W., October, 1906.
Superintendent, Westchester Lighting Company, First Avenue and First Street, Mount Vernon, New York.

Griffin, Orange G., September, 1913.
Draughtsman, Consolidated Gas Company, 1854 Seventh Avenue, New York, New York.

Griffis, Rowland Elliot, September, 1913.
Inspector of Traffic Handling, United Gas Improvement Company, 24 North 22d Street, Philadelphia, Pennsylvania.

Griffiths, Chester A. A., March, 1914.
Engineer's Assistant, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Griffiths, Norman James, September, 1913.
Statistical Clerk, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Gross, Harry O., September, 1909.
Chief Clerk, Transportation Division, The United Gas Improvement Company, 4650 Market Street, Philadelphia, Pennsylvania.

Haldeman, Clifford L., September, 1911.
The United Gas Improvement Company, 2963 Bailey Street, Philadelphia, Pennsylvania.

Hamilton, Earl R., September, 1911.
Chemical Engineer, Fall River Gas Works Company, 155 North Main Street, Fall River, Massachusetts.

Hammond, Eric W., October, 1906.
Superintendent of Meter Repair Shop, Kansas City Gas Company, 910 Grand Avenue, Kansas City, Missouri.

Hansen, Alfred H., September, 1912.
Tar Salesman, Omaha Gas Company, 416 Woolworth Avenue, Omaha, Nebraska.

Haralson, James M., March, 1915.
Engineering Assistant, Utilization Department, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Hartsock, L. H., March, 1915.
District Manager, Pacific Gas & Electric Company, 120 Fifth Street, Colusa, California.

Hayward, Harold A., March, 1911.
Assistant General Manager, Connelly Iron Sponge & Governor Company, 127 Duane Street, New York, New York.

Heavner, LeRoy Clements, March, 1911.
Tampa, Florida.

Helman, Hiram, September, 1913.
Athol Gas & Electric Company, Athol, Massachusetts.

Henson, Edward B., September, 1910.
Distribution Foreman, Gas Plant, San Antonio Gas & Electric Company, 504 Goliad Street, San Antonio, Texas.

Hill, Daniel L., March, 1911.
Superintendent of Records, Toronto Gas Company, 19 Toronto Street, Toronto, Canada.

Hoff, John F., March, 1913.
Superintendent, Public Service Gas Company, 45 Witherspoon Street, Princeton, New Jersey.

Hoffman, Armin Standish, March, 1914.
Mechanical Engineer, The Texas Company, 17 Battery Place, New York, New York.

Howard, Charles O. S., September, 1912.
Engineer, Colon Gas Company, Colon, Panama.

Howell, Francis Kitchell, September, 1916. (P)
Cadet Engineer, Coal Products Manufacturing Company, Joliet, Illinois.

Humphreys, Russell Garretson, March, 1914.
Assistant in Engineering Department, Lawrence Gas Company, 370 Essex Street, Lawrence, Massachusetts.

Hunt, Harold William, September, 1914.
Apprentice, Detroit City Gas Company, Station A, Detroit, Michigan.

Hyland, Harry B., March, 1914.
Assistant Superintendent, Consolidated Gas Company, 66th Street and West End Avenue, New York, New York.

Jones, Charles C., March, 1914.
Assistant Supt. Distribution, The United Gas Improvement Company, 2139 West Ontario Street, Philadelphia, Pennsylvania.

Jones, Dwight Williams, September, 1915.
Cadet Enginer, Pacific Gas & Electric Company, 2031 Vallejo Street, San Francisco, California.

Jones, Leon B., September, 1912.
Assistant Engineer, Gas Department, Pacific Gas & Electric Company, Foot Humboldt Street, San Francisco, California.

Kane, Milford L., September, 1911. (P)
General Manager, Brandon Gas & Power Company, Ltd., Brandon, Manitoba, Canada.

Kawai, Hideichi, September, 1912.
Engineer, Ichigi, Takahashinuna Nishikamogun, Mikawa, Japan.

Keeler, Earl E., March, 1912.
General Shop Foreman, Kansas City Gas Company, 910 Grand Avenue, Kansas City, Missouri.

Kellogg, Harrison B., September, 1909.
Engineer, Westchester Lighting Company, 107 Warburton Avenue, Yonkers, New York.

Kingsbury, I. Clayton, March, 1909. (P)
Assistant Superintendent, Mains and Services, Consolidated Gas Company, 134 East 15th Street, New York, New York.

Klar, Robert Lyle, March, 1914.
Superintendent Works, Northern Indiana Gas & Electric Light Company, 1203 Rivermont Avenue, Fort Wayne, Indiana.

KNOTHE, W. J., October, 1906.
3428 Moncrieff Place, Denver, Colorado.

KOLLOCK, EDWARD CAMPBELL, March, 1913.
Superintendent, Gas Dept., Charleston Consolidated Railway & Lighting Co., 141 Meeting Street, Charleston, South Carolina.

KRUGER, PAUL, September, 1914.
Prepayment Bookkeeper, Westchester Lighting Company, 472 Franklin Avenue, Mount Vernon, New York.

LAFORE, PAUL JULES, September, 1909.
With Surface Combustion Company, 6246 Limekiln Pike, Philadelphia, Pennsylvania.

LAKE, MORTON, September, 1915. (P)
Foreman, Gas Meter Shop, St. Paul Gas Light Company, 112 East Lawson Street, St. Paul, Minnesota.

LATHAM, FRANK WILLIAM, September, 1916.
Superintendent, Alexandria Gas Works, 200 Prince Street, Alexandria, Virginia.

LAUDLAW, SAMUEL A., September, 1916.
General Foreman, Fitting Department, Laclede Gas Light Company, 1136 North Kingshighway, St. Louis, Missouri.

LEUENBERGER, WALTER ARNOLD, March, 1908.
Superintendent, Tacoma Gas Company, 22d and Dock Streets, Tacoma, Washington.

LEVAN, DANIEL H., September, 1915.
Cadet Engineer, Omaha Gas Company, 1509 Howard Street, Omaha, Nebraska.

LOCKWOOD, ALAN E., September, 1915.
Manager, Bluefield Gas & Power Company, Bluefield, West Virginia.

MACSAVENY, ROBERT JR., March, 1914.
Night Foreman, Brooklyn Union Gas Company, Foot North 12th Street, Brooklyn, New York.

MCCARTHY, ALBERT P., March, 1911.
Engineer, Philadelphia Suburban Gas & Electric Company, Coatesville, Pennsylvania.

MCELEVEY, JAMES, September, 1916.
General Fitter Foreman, Laclede Gas Light Company, 1136 North Kingshighway, St. Louis, Missouri.

Malakoff, John, September, 1912.
General Foreman, Gas Works, Westchester Lighting Company, Spring Street, White Plains, New York.

Malin, J. H., September, 1912.
Storekeeper, Omaha Gas Company, 1202 Howard Street, Omaha, Nebraska.

Maloney, George Joseph, March, 1914.
Superintendent, Kennett Gas Company, Kennett Square, Pennsylvania.

Marsh, Edward H., September, 1913.
Shop Foreman, Queens Borough Gas & Electric Company, 326 Clermont Avenue, Brooklyn, New York.

Mayfield, Paul C., March, 1914.
Assistant Superintendent, The United Gas Improvement Company, 3817 North Bouvier Street, Philadelphia, Pennsylvania.

Minard, Emory D., September, 1913.
General Foreman, Public Service Gas Company, 118 Main Street, Hackensack, New Jersey.

Mitchell, Herman W., March, 1914.
Cashier and Office Manager, Rome Gas, Electric Light & Power Company, 139 North James Street, Rome, New York.

Mitchell, Wylie, March, 1914. (P)
Superintendent Distribution, St. Joseph Gas Company, 802 Francis Street, St. Joseph, Missouri.

Morrissey, James J., September, 1916.
Chemist, Philadelphia Suburban Gas & Electric Company Coke Ovens, Chester, Pennsylvania.

Morrison, Martin, September, 1912.
Cadet Engineer, New York & Queens Gas Company, 82 Myrtle Avenue, Flushing, New York.

Moyer, Wayne R., September, 1913.
Assistant Superintendent, United Gas Improvement Company, 446 West Martin St., Roxborough, Philadelphia, Pennsylvania.

Mueller, Adolph F., March, 1910.
Head Bookkeeper, Seattle Lighting Company, Seattle, Washington.

Muller, Herman, Jr., September, 1908.
Works Assistant, New York & Richmond Gas Company, 691 Bay Street, Stapleton, Staten Island, New York.

Murphy, Albert Francis, September, 1912.
Assistant to Superintendent, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Murphy, Harold Purves, March, 1914.
Cadet Engineer, The United Gas Improvement Company, 116 West Penn Street, Germantown, Philadelphia, Pennsylvania.

Nason, Forest J., September, 1913.
Clerk, Blackstone Valley Gas & Electric Company, Woonsocket, Rhode Island.

Neal, George A., September, 1912. (P)
Engineer's Assistant, Northern Indiana Gas & Electric Company, Hammond, Indiana.

Nelson, E. A., March, 1909.
Engineering Assistant of Mains and Services, Consolidated Gas Company, 80 Elizabeth Street, New York, New York.

Nelson, William Harris, March, 1914.
Cadet Engineer, St. Paul Gas Light Company, 6th and Jackson Streets, St. Paul, Minnesota.

Neth, John A., October, 1906.
Foreman, Gas Department, Westchester Lighting Company, 14 Archer Park, Tarrytown, New York.

Nies, H. O., September, 1916.
General Street Foreman, Distribution Department, Laclede Gas Light Company, 1940 Louisiana Avenue, St. Louis, Missouri.

O'Keeffe, James Garwood, March, 1908.
Market Street Works, Public Service Gas Company, Newark, New Jersey.

Osborn, Norris Whitlock, March, 1915.
Gas Engineer, 339 Winthrop Avenue, New Haven, Connecticut.

Palmer, Alva L., September, 1913. (P)
Engineer's Assistant, Department of Utilization, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Pearce, William Faulkner, March, 1908.
Montreal, Canada.

PEDEN, HUGH L., March, 1909.
Assistant Superintendent, Distribution Department, Consolidated Gas Company, 130 East 15th Street, New York, New York.

PERKINS, MATTHEW F., September, 1909.
Chief Canvasser, The United Gas Improvement Company, 5813 Thompson Street, Philadelphia, Pennsylvania.

PFEIFFER, BERNARD V., September, 1911. (P)
Engineer, Nashville Gas & Heating Company, 722 Second Avenue, North, Nashville, Tennessee.

PLATT, LOUIS JULIUS, September, 1914.
Industrial Fuel Representative, Public Service Gas Company, 909 Park Avenue, Hoboken, New Jersey.

POSTLES, JOHN V., September, 1913.
Cadet Engineer, 115 South 22d Street, Philadelphia, Pennsylvania.

PUGH, FRANK S., September, 1914.
Foreman of Mains and Services, Porto Rico Gas Company, Fernland Farm, Rio Piedras, Porto Rico.

RASCH, WM. T., March, 1909. (P)
Assistant to Engineer of Utilization, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

READING, HARRY BRUCE, September, 1915.
Laboratory Assistant, Brooklyn Union Gas Company, Nevins and DeGraw Streets, Brooklyn, New York.

REINER, OTTO, September, 1912.
General Foreman, Public Service Gas Company, 41 Front Street, Newark, New Jersey.

REYNOLDS, JAMES FISHER, September, 1913.
Industrial Salesman, Consolidated Gas Company, 130 East 15th Street, New York, New York.

RHODES, LEWIS B., JR., September, 1916.
Post Office Box 111, West Lafayette, Indiana.

RICHARDSON, R. B., September, 1914.
Assistant Gas Engineer, Illinois Traction Company, 604 South Boyd Street, Decatur, Illinois.

RIORDAN, DANIEL, March, 1913.
Chief Clerk in Works Office, Consolidated Gas Company, 501 East 21st Street, New York, New York.

Ritchie, Arthur Robson, March, 1911.
Superintendent, Consolidated Gas Company, 14th Street and Avenue C, New York, New York.

Roberson, Jay C., March, 1913.
Superintendent of Distribution, Public Service Gas Company, Peace and Washington Streets, New Brunswick, New Jersey.

Root, William A., March, 1915.
Commercial Manager, Bronx Gas & Electric Company, 2358 Lyon Avenue, Bronx, New York, New York.

Russell, James, September, 1913.
Assistant Chief Draughtsman, The United Gas Improvement Company, 3141 North 17th Street, Philadelphia, Pennsylvania.

Saylor, Rayford Clark, September, 1916.
Secretary, Hagerstown Light & Heat Company, 86 West Washington Street, Hagerstown, Maryland.

Schell, William F., March, 1913. (P)
Mechanical Engineer, Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

Schlegel, Carl A., September, 1913.
Engineer of Construction, Northern Indiana Gas & Electric Company, South Bend, Indiana.

Schroeder, Carl Robert, March, 1912.
Cadet Engineer, Distribution Department, Public Service Gas Company, 1045 Bloomfield Street, Hoboken, New Jersey.

Schuck, Conrad, Jr., March, 1911. (P)
Assistant Superintendent, Public Service Gas Company, Morristown, New Jersey.

Scott, William Doke, March, 1914.
In charge Water Gas Plant, New Haven Gas Light Company, 80 Crown Street, New Haven, Connecticut.

See, Milton, Jr., September, 1916.
Superintendent's Assistant, Brooklyn Union Gas Company, 556 Kent Avenue, Brooklyn, New York.

Seeley, Harold K., September, 1913.
Assistant Superintendent, City District, United Gas Improvement Company, 1931 South 9th Street, Philadelphia, Pennsylvania.

Shaughnessy, Thomas, Jr., September, 1912. (P)
Engineer's Assistant, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Sheehy, John Charles, September, 1911.
Distribution Foreman, Queens Borough Gas & Electric Company, 347 Central Avenue, Far Rockaway, New York.

Sherwood, Herbert, September, 1910.
Superintendent, Westchester Lighting Company, 119 Woodworth Avenue, Yonkers, New York.

Smith, George Howard, March, 1914. (P)
Assistant District Superintendent, Central Hudson Gas & Electric Company, 129 Broadway, Newburgh, New York.

Smith, George Lathrop, September, 1913.
1909 North 17th Street, Philadelphia, Pennsylvania.

Smythe, Charles W., March, 1916.
Manufacturing Department, Public Service Gas Company, Duffield and St. Paul Avenues, Jersey City, New Jersey.

Sommar, Alban M., March, 1913.
Chief Clerk, Omaha Gas Company, 1509 Howard Street, Omaha, Nebraska.

Staniford, Robert Hutson, September, 1916.
Superintendent's Assistant, Brooklyn Union Gas Company, 556 Kent Avenue, Brooklyn, New York.

Steere, Frank W., September, 1914.
Vice-President and Chief Engineer, Steere Engineering Company, Woodward and Horton Avenues, Detroit, Michigan.

Stirzel, Jacob Wm., Jr., September, 1916.
Cadet Engineer, The United Gas Improvement Company, Point Breeze Gas Works, Philadelphia, Pennsylvania.

Strader, Roland Howard, March, 1915.
Junior Assistant to Superintendent, Standard Gas Light Company, 710 Chauncey Street, Brooklyn, New York.

Swearingen, Henry Grady, September, 1916. (P)
Superintendent, Distribution Gas Department, Evansville Public Service Company, 124 Upper Second Street, Evansville, Indiana.

Taber, William B., Jr., September, 1915.
Supt., The Aetna Explosives Company, New York, New York. (1139 South 7th Street, Terre Haute, Indiana.)

Tarrant, Stanley G., March, 1912.
Statistician, Westchester Lighting Company, 438 South 4th Avenue, Mount Vernon, New York.

Taylor, Percival Drayton, March, 1914.
Engineer, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Tenney, George C., March, 1912.
Mechanical Engineer, Public Service Gas Company, 33 Prospect Street, Elizabeth, New Jersey.

Tinney, Thomas Brown, March, 1913.
Chemist, The United Gas Improvement Company, 303 Lafayette Avenue, Collingdale, Pennsylvania.

Torrey, Bates, Jr., March, 1915.
Cadet Engineer, Semet-Solvay Company, 1410 South Geddes Street, Syracuse, New York.

Tour, Reuben S., March, 1912.
Assistant Professor of Gas Engineering, University of California, Mechanics Building, Berkeley, California.

Tozier, George E., September, 1914.
Gas Light Company of Augusta, 704 Broad Street, Augusta, Georgia.

Travis, George W. Leroy, September, 1912. (P)
Assistant Engineer, Department Mains and Services, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Van Vliet, Rutherford, September, 1914.
Assistant to Superintendent, Detroit City Gas Company, Station B, Detroit, Michigan.

Vecker, Samuel P., March, 1912.
Engineer, 308 Widener Building, Philadelphia, Pennsylvania.

Vredenburgh, Frank W., September, 1915.
Supervisor of Gas Distribution, Central Hudson Gas & Electric Company, 128 Broadway, Newburgh, New York.

Warner, Charles Pierie, March, 1910.
Cadet Engineer, Allentown-Bethlehem Gas Company, Allentown, Pennsylvania.

Wellwood, Arthur R., March, 1914.
Assistant District Superintendent, Central Hudson Gas & Electric Company, 50 Market Street, Poughkeepsie, New York.

Welsh, M. G., September, 1915. (P)
Superintendent, Mohawk Gas Company, 17 Springfield Avenue, Schenectady, New York.

White, Albert Ray, March, 1915.
With Menominee & Marionette Light & Traction Company, Menominee, Michigan.

WILLIAMS, JOSEPH A., September, 1916.
Inspector of High Pressure Manholes and Valves, Laclede Gas Light Company, 1017 Olive Street, St. Louis, Missouri.

WILSON, CHARLES JAMES, March, 1914.
Salesman, St. Clair County Gas & Electric Company, East St. Louis, Illinois.

WILSON, WARD, October, 1906.
Foreman of Distribution, Lynchburg Traction & Light Company, 316 Euclid Avenue, Lynchburg, Virginia.

WIMBERLY, ALBERT HOMER, September, 1914.
Foreman, Distribution Shop, Atlanta Gas Light Company, Electric and Gas Building, Atlanta, Georgia.

WISKE, PRESCOTT B., March, 1913.
Assistant Superintendent, Shop Distribution Department, Brooklyn Union Gas Company, 176 Remsen St., Brooklyn, New York.

WOOD, FRANK A., September, 1912.
7 Florida Street, Dorchester, Massachusetts.

WOOD, WILLIAM MAXWELL, March, 1916.
Local Manager, Pacific Power & Light Company, Lewiston, Idaho.

WRIGHT, WILLIAM GANO, September, 1912.
Street Clerk, Westchester Lighting Company, 119 Woodworth Avenue, Yonkers, New York.

ZANE, ALLEN HERBERT, March, 1914.
Superintendent's Assistant, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

ZOOK, SAMUEL KURTZ, October, 1906.
Superintendent, Public Service Gas Company, Washington and Peace Streets, New Brunswick, New Jersey.

Total Junior Members 186

AFFILIATE MEMBERS.

ARDRY, MELVIN L.
753 Hackett Avenue, Milwaukee, Wisconsin.

BAIR, E. E.
Conewago Gas Company, Hanover, Pennsylvania.

BAKER, VERNON.
Care of Russell Engineering Company, International Life Building, St. Louis, Missouri.

BALDWIN, W. D.
Harrisburg Gas Company, Harrisburg, Pennsylvania.

BECK, H. M.
Easton Gas & Electric Company, 113 Bushkill Street, Easton, Pennsylvania.

BENNETT, H. E.
Cherokee Gas Company, Cherokee, Iowa.

BIALECKI, STEPHEN.
742½ 46th Street, Milwaukee, Wisconsin.

BILLINGS, WILLIAM.
203 22nd Street, Milwaukee, Wisconsin.

BLONIEN, E.
449 Summitt Avenue, Milwaukee, Wisconsin.

BREWER, EDWARD D.
45 Poplar Circle, Atlanta, Georgia.

BRITTON, J. A.
Pennsylvania Lighting Company, Shamokin, Pennsylvania.

BULLARD, F. J.
Hagerstown Light & Heating Company, Hagerstown, Maryland.

BURGNER, M. K.
Chambersburg Gas Company, Chambersburg, Pennsylvania.

BUTTERWORTH, WM. C.
Platteville Gas Company, Platteville, Wisconsin.

CARSON, A. G.
Eastern Wisconsin Railway & Light Company, Fond du Lac, Wisconsin.

CAUSBROOK, EUGENE.
Mauch Chunk Gas Company, Mauch Chunk, Pennsylvania.

CURTIS, F. E.
5521 Kimbark Avenue, Chicago, Illinois.

DAWSON, B. G.
Fairbury Gas Company, Fairbury, Nebraska.

DUMMETT, H. O.
Care of Hotel Kellogg, Omaha, Nebraska.

Dutton, H. S.
Chester County Gas Company, West Chester, Pennsylvania.

Easterly, H. W.
Sheboygan Gas Light Company, Sheboygan, Wisconsin.

Eastman, J. Peter.
Manitowoc Gas Company, Manitowoc, Wisconsin.

Faller, C.
Carlisle Gas & Water Company, Carlisle, Pennsylvania.

Falvey, E. C.
Sprague Meter Company, Davenport, Iowa.

Fischer, A. J.
Peninsular Stove Company, Detroit, Michigan.

Fisler, Frank B.
Mount Carmel Gas Light Company, Mount Carmel, Pennsylvania.

Fiss, W. S.
Philadelphia Suburban Gas & Electric Company, Wyncote, Pennsylvania.

Gaylord, J. H.
Luzerne County Gas & Electric Company, Kingston, Pennsylvania.

Glahn, Fred.
461 Second Avenue, Milwaukee, Wisconsin.

Grant, T. E.
Care of Humphrey Company, Kalamazoo, Michigan.

Grayson, Theo. J.
1327 Real Estate Trust Building, Philadelphia, Pennsylvania.

Gregg, Guy F.
239 29th Street, Milwaukee, Wisconsin.

Grimm, C. C.
Suburban Gas & Fuel Company, Dallastown, Pennsylvania.

Haertel, W. T.
1524 Hadley Street, Milwaukee, Wisconsin.

Halloran, Richard J.
Easton Gas Company, Easton, Pennsylvania.

Hambright, D. M.
Bangor Gas Company, Bangor, Pennsylvania.

HAMMETT, FRED.
884 44th Street, Milwaukee, Wisconsin.

HARMAN, HENRY.
833 Grant Boulevard, Milwaukee, Wisconsin.

HARR, DEWITT C.
6911 Wayne Avenue, Chicago, Illinois.

HASELTINE, W. E.
Ripon Light & Water Company, Ripon, Wisconsin.

HERMANN, ROBERT.
1044 4th Street, Milwaukee, Wisconsin.

HERSH, GRIER.
York Gas Company, York, Pennsylvania.

HODGES, GEORGE B.
Northern Central Gas Company, Williamsport, Pennsylvania.

HOFFMAN, CHARLES L.
Consumers Gas Company, Reading, Pennsylvania.

IVES, HOLMES.
Wisconsin-Minnesota Light & Power Company, Chippewa Falls, Wisconsin.

JASPERSON, R. O.
414 Webster Place, Milwaukee, Wisconsin.

JOHONOTT, H. W.
Monroe Light & Fuel Company, Monroe, Wisconsin.

JONES, FRANK A.
Care of Ruud Manufacturing Company, 89 Biddle Street, Milwaukee, Wisconsin.

JONES, WILLIAM.
Wisconsin Traction, Light, Heat & Power Company, Appleton, Wisconsin.

KEMEN, W. E.
386 27th Street, Milwaukee, Wisconsin.

KOERTS, HENRY.
408 Hanover Street, Milwaukee, Wisconsin.

KRETLOW, ALBERT.
2109 Galena Street, Milwaukee, Wisconsin.

KURTZ, ADAM.
982 Island Avenue, Milwaukee, Wisconsin.

LIGHTFOOT, J. C., JR.
Real Estate Trust Building, Philadelphia, Pennsylvania.

LLEWELLYN, A. J.
Luzerne County Gas & Electric Company, Kingston, Pennsylvania.

MCKNIGHT, J.
Pottsville Gas Company, Pottsville, Pennsylvania.

MACPHERSON, W. J.
Public Service Gas Company, Blue Island, Illinois.

MANLEY, A. R.
Wisconsin-Minnesota Light & Power Company, Eau Claire, Wisconsin.

MASON, ALPHONSO.
Welsbach Company, Gloucester City, New Jersey.

MONCRIEFF, J. W.
Wisconsin-Minnesota Light & Power Company, La Crosse, Wisconsin.

MORGAN, CHARLES S.
Manager, Logan County Gas Company, Lincoln, Illinois.

MORRIS, ALBERT.
Peoples Light Company, Pittston, Pennsylvania.

MORRIS, W. A.
Wilmington Gas Company, Wilmington, Delaware.

NORMAN, O. E.
Gas Company, 122 South Michigan Avenue, Chicago, Illinois.

PIERCE, ROBERT FFRENCH.
Welsbach Company, Gloucester, New Jersey.

POST, ALFRED P.
American Gas Company, West Washington Square, Philadelphia, Pennsylvania.

RICE, THOMAS.
Gage County Gas Light & Power Company, Beatrice, Nebraska.

RITCHIE, RALPH J.
Peoples Gas Company, Shenandoah, Iowa.

ROPER, WINFIELD.
Slatington Gas Company, Slatington, Pennsylvania.

RUSSELL, EDWARD G.
Consumers Gas Company, Reading, Pennsylvania.

Schaper, H. C.
1582 Prospect Avenue, Milwaukee, Wisconsin.

Scherr, Alpheus B.
Carbondale Gas Company, Carbondale, Pennsylvania.

Smith, Charles S.
American Gas Company, West Washington Square, Philadelphia, Pennsylvania.

Smith, E. L.
Towanda Gas Company, Towanda, Pennsylvania.

Smyly, Arthur L.
Connelly Iron Sponge & Governor Company, 1000 West 22nd Street, Chicago, Illinois.

Spence, Thomas E.
Philadelphia Suburban Gas & Electric Company, Phoenixville, Pennsylvania.

Stem, F. B.
Penn Central Light & Power Company, 611 Chestnut Street, Philadelphia, Pennsylvania.

Tenney, D. C.
American Gas Construction Company, Newton, Iowa.

Vanden Bout, J.
Columbia & Montour Electric Company, Danville, Pennsylvania.

Vincent, H. B.
Penn Central Light & Power Company, 611 Chestnut Street, Philadelphia, Pennsylvania.

Von Nieda, H. J.
Lancaster Gas Light & Fuel Company, Lancaster, Pennsylvania.

Wakeman, C. A.
Wilkes-Barre Gas Company, Wilkes-Barre, Pennsylvania.

Walker, J. H.
638 Downer Avenue, Milwaukee, Wisconsin.

Wallace, A. I.
936 Windsor Avenue, Chicago, Illinois.

Ware, Leon H.
Martinsburg Gas Company, Martinsburg, West Virginia.

Weak, C. H.
6823 Milton Street, Mt. Airy, Philadelphia, Pennsylvania.

Wiggers, Charles.
3722 Galena Street, Milwaukee, Wisconsin.

Total Affiliate Members 87

SUMMARY.

Honorary	3
Life	2
Active	1,137
Associate	220
Junior	186
Affiliate	87
Total	1,635

SECTIONAL REGISTRATION.

Letters following the name designate the Section in which the member is registered.

A—Accounting Section.
C—Chemical Section.
D—Distribution Section.
I—Illumination Section.
M—Manufacturing Section.

CONSTITUTION—SECTION 39. " * * * Any member of the Institute may attend the meeting of any section at any time. Any Honorary, Active, Associate or Junior member in good standing may vote on the election of section officers or on any other matters connected with section organization in one section only, and to so vote must register as a voting member of such section. * * * "

BY-LAW 24 (SECTION 39). "The voting lists for section matters shall be drawn up from the list of members as published in the last volume of the PROCEEDINGS, in which the section registration of each member shall be shown."

MEMBERS OF THE AMERICAN GAS INSTITUTE ARRANGED GEOGRAPHICALLY.

ALABAMA

Birmingham

J. E. Montgomery (D)
R. John Titzel

Mobile

Albert F. Kersting (M)

Montgomery

H. D. Frueauff

Selma

R. L. Ellis

ARKANSAS

Little Rock

W. F. Booth

CALIFORNIA

Berkeley

J. S. Haug
Reuben S. Tour (M)

Colusa

L. H. Hartsock

Jackson

B. E. Letang

Los Angeles

F. R. Bain
William Baurhyte (D)
Jos. M. Berkley
Frank Cavenagh
W. B. Cline
John T. Creighton (M)
Addison B. Day (C)
William J. Dorr (D)
Robt. F. Fitz
J. D. Hackstaff
Charles P. Houghton (M)
H. J. Kister
Charles A. Luckenbach (I)
A. B. Macbeth (D)
Thomas P. McCrea (A)
F. C. Millard (D)
J. F. Porter (A)
F. J. Schafer
A. F. Shattuck (C)
C. S. Vance (A)

Modesto

Frank A. Cressey, Jr.

Oakland

F. A. Leach, Jr. (D)

Pasadena

C. W. Koiner (D)

Sacramento

E. S. Jones (M)

San Diego

Henry H. Jones

San Francisco

C. B. Babcock
John A. Britton
J. A. Britton, Jr. (M)
V. E. Britton (M)
F. G. Drum
Sherwood Grover (D)
W. M. Henderson (D)
A. F. Hockenbeamer
D. W. Jones (M)
Edward C. Jones (M)
Leon B. Jones (M)
D. E. Keppelmann (D)
John Martin
C. O. G. Miller (A)
Saml. L. Naphtaly
R. J. Thompson (I)
Wm. von Phul

CALIFORNIA—*Continued*

San Jose
Robert H. Hargreaves
John D. Kuster

Santa Monica
W. S. Dole (M)

San Rafael
A. J. Rix (M)

Upland
Isaac C. Baxter (M)

COLORADO

Denver
W. J. Knothe
M. E. Malone (D)
Clare N. Stannard (I)
A. F. Traver (M)
George Wehrle

Pueblo
James M. Dailey

CONNECTICUT

Bridgeport
C. M. Gerdenier (M)
Wm. P. Hutchinson (D)
Ralph I. Munson (A)
A. J. Palmer (M)
Geo. W. Roberts
H. H. Sprague

Danbury
G. E. Cowperthwaite (M)

Derby
C. H. Nettleton (M)
G. H. Scranton

Hartford
P. R. Buchanan
E. E. Eysenbach
J. A. McArthur

Meriden
Charles A. Learned (M)

Middletown
Edgar C. Weston (M)

Milford
William Reeves

New Haven
Philmer Eves
W. H. Hinman
J. Arnold Norcross (M)
N. W. Osborn (C)
W. D. Scott (D)
T. R. Sucher (D)
C. E. Thompson
H. E. White (M)
Robert E. Wyant (M)

New London
V. E. Bird

Norwalk
G. H. Caffrey (M)

Stamford
Henry J. Warren
John A. Waters

Stepney Depot
F. B. Wheeler

Thompson
C. L. Gerould (M)

Thompsonville
W. P. Schwabe (D)

Torrington
Frank M. Travis

Waterbury
L. L. Cadwallader
E. H. Williams

DELAWARE

Wilmington
Wm. J. McCorkindale (D)
W. A. Morris

DISTRICT OF COLUMBIA

Washington

C. Clay Bayly
Frederic Egner
Thomas F. Holden
T. B. Hopper
R. S. McBride
James S. McIlhenny
Howard Reeside
C. E. Reinicker (D)
T. Symmes Tincher
S. N. Whitwell (A)

FLORIDA

Jacksonville

C. S. Hammatt (D, I, M)
T. C. Gibbs
Harry B. Hoyt

Pensacola

Charles F. Zeek (M)

St. Augustine

Daniel Fitzpatrick (M)
C. L. Lyon

Tampa

LeRoy C. Heavner
Rosco Nettles

GEORGIA

Atlanta

P. S. Arkwright
E. D. Brewer
R. C. Congdon
C. J. Weinmeister (D)
A. D. Whittaker (M)
A. H. Wimberly

Augusta

F. L. Marshall (D)
W. H. Matlack, Jr. (M)
Morris D. Schindler
G. E. Tozier

Columbus

MacDougald Dexter

Macon

George R. Horning (M)

Rome

James Ferrier

Savannah

J. L. Cabell (M)
C. F. Carter
John W. Golden (D)
J. C. Grey

Waycross

David S. Long (M)

IDAHO

Boise

Carroll E. Gray

Lewiston

Wm. M. Wood

ILLINOIS

Aurora

C. C. Boardman
I. C. Copley
H. W. Edmund
F. M. James
Carroll Miller (M)
F. E. Robinson
R. N. Strohn
W. M. Willett

Batavia

F. W. Vilven

Blue Island

W. J. MacPherson

Chicago

Wm. H. Allen, Jr. (M)
Harold Almert
Knowlton L. Ames (M)
C. F. Asendorf
Wm. A. Baehr (M)
F. J. Baker
R. W. Bingham (I)
Chas. W. Bradley

ILLINOIS—*Continued*

Chicago

J. H. Cavender
S. K. Chase
A. A. Chichester
H. H. Clark (D)
R. K. Clark
Mathias Connors (M)
Edward G. Cowdery
A. D. Cressler
G. H. Cressler
F. G. Curfman
F. E. Curtis
James E. Davies (D)
R. N. Davis
Wm. W. Davis
H. M. Dawes
Rufus C. Dawes
C. L. Day
Alfred B. Eaton (M)
L. B. Elliott (D)
I. C. Elston, Jr.
Ralph Esau
John H. Eustace (M)
H. H. Field (M)
F. J. Fleischhauer
J. F. Gilchrist
John Ginley
H. D. Harper
R. B. Harper (C)
D. C. Harr
Julian G. Hart (M)
W. E. Hartman
Homer T. Hirst, Jr.
Jesse B. Hirst
H. R. Hunt
William B. Jackson
B. J. Kellum
F. A. Lathrop
J. W. Lawlor (M)
Henry I Lea
J. G. Learned
Thomas J. Lucas (M)
A. J. Luick (M)
F. E. Luther (M)
J. N. McCallum
F. G. Manly (M)
Joseph C. Markley
Charles W. Melcher (D)
C. W. Meloney
T. D. Miller (M)
Thomas N. Mordue
John M. Morehead (C)
Edward E. Morrell
C. A. Munroe
O. E. Norman
Wm. J. Norton (A)
George G. Olmsted
Otto E. Osthoff
D. W. Penington
L. R. Phillips
Edward G. Pratt (M)
Theo. V. Purcell (A)
James A. Rafferty (M)
S. A. Reinhard (M)
Irwin Rew
Rudolph Schenck (M)
A. L. Smyly
Jacob M. Spitzglass (M)
W. D. Sweetman
E. H. Taylor
A. L. Tossell
J. S. Unger
A. I. Wallace
E. H. Wetlaufer
Lyman A. Wiley
John Williamson
W. G. Woolfolk
Herman Zitzewitz

Decatur

Robert Mueller (D)
R. B. Richardson (M)

Dixon

Justin E. Harlow

ILLINOIS—*Continued*

East St. Louis
C. H. Quackenbush (M)
C. J. Wilson

Elgin
J. H. Owens
C. B. Strohn

Evanston
Andrew McIntyre (M)

Freeport
E. D. V. Dickey

Glen Ellyn
E. A. Dieterle

Joliet
W. R. Bigelow
A. H. Harris, Jr. (M)
F. K. Howell
H. J. Mitchell
W. J. Murdock
H. E. Weeks

Kankakee
F. E. Newberry (M)

Kewanee
Elmer W. Smith

La Grange
C. I. Carlson

Marion
H. L. Farrar
F. K. Lamb

Mendota
E. W. Galloway (M)

Mount Vernon
H. E. Brandli

Oak Park
Mathias Britsch

Peoria
H. E. Chubbuck
Ross S. Wallace

Quincy
Harry O. Channon (M)
Charles McDonnell (M)

Rockford
A. W. Kendall
Garnet W. McKee
J. F. Parker
George D. Roper (M)
S. G. Smith
Henry S. Whipple (A)
W. A. Wilson

Rock Island
D. G. Porter

Springfield
G. H. Dawson
A. S. B. Little
C. H. Lanphier

Waukegan
Albert C. Goodnow
George F. Goodnow (M)

Wheaton
Edward Garrity

Woodstock
D. M. Workman

INDIANA

Anderson
M. G. Reynolds

Columbus
C. M. Keller

Connersville
George C. Hicks, Jr. (M)
E. D. Johnston (M)
J. S. Tatman

Elkhart
John A. Patten

Evansville
R. L. Klar
H. G. Swearingen

INDIANA—*Continued*

Fort Wayne
Fred W. Freese
Olaf N. Guldlin
S. E. Mulholland (D)
Thomas W. Stone
Orrell O. Thwing
John V. Wills

Gary
Leonard Fitzgerald (M)

Greencastle
John G. Martin

Hammond
H. W. Duncan
H. C. Miller (A)
G. A. Neal (D, M)
B. S. Walters (M)

Indianapolis
H. M. Chapman (M)
S. T. Murdock
Frank W. Sargeant (D)
George Summers (D, M)
W. H. Wright (M)

Muncie
J. E. Colvin
J. H. Maxon (D)

New Albany
James W. Dunbar (M)

Peru
T. B. Genay (M)

Plymouth
W. E. Nichols

Princeton
Harry Firstbrook

Rochester
E. C. Collier

South Bend
H. V. Armstrong
C. N. Chubb (M)
C. A. Schlegel

Terre Haute
C. D. Shaul (M)

Valparaiso
LeRoy O. Gordon (M)

West Lafayette
L. B. Rhodes, Jr.

IOWA

Boone
H. G. Stillson (M)

Burlington
Edward D. Clary

Cedar Rapids
H. J. Carson
Thomas Suchomel

Charles City
R. K. Runner

Cherokee
H. E. Bennett

Clinton
Thomas Crawford

Council Bluffs
A. L. English

Davenport
H. C. Blackwell
B. J. Denman
E. C. Falvey
D. G. Fisher
Ernest Jacobson

Des Moines
Jansen Haines
E. H. Martin (I)

Dubuque
George McLean
Edwin M. Walker (M)

Fort Dodge
R. B. MacDonald

Muscatine
F. S. Dewey

IOWA—*Continued*

Newton
D. C. Tenney

Oskaloosa
A. H. R. Jackson

Shenandoah
R. J. Ritchie

Sioux City
Wm. J. Bertke
L. L. Kellogg (M)

Washington
George S. Carson

Waterloo
Austin Burt (D)
H. M. Smith

Webster City
Campbell W. Fair (A)

KANSAS

Caney
L. B. Moorhouse

Emporia
W. M. Russell

Independence
V. A. Hays

Kansas City
W. H. McKenzie
C. H. Waring (D)

Lawrence
C. J. Dodds

Salina
J. E. Harsh

Topeka
George J. Swan (D, M)
L. G. Treleaven (A)

KENTUCKY

Louisville
William H. Crutcher
Geo. H. Harries
Frank Huber (D, I, M)
Donald McDonald

Paducah
Fred Cloen

Richmond
Benj. A. Dougherty

LOUISIANA

Hammond
F. W. Reimers

New Orleans
Geo. H. Davis
H. M. Harriman

MAINE

Augusta
Walter S. Wyman

Bangor
O. A. Merchant, Jr. (M)

Harpswell
E. E. Witherby (M)

Lewiston
John J. Scott

Portland
Fred N. Dow
A. H. Ford
C. O. Pratt (M)
Burton Smart

MARYLAND

Baltimore
George R. Althen (D)
George Beadenkopf (M)
Howard Bruce
C. H. Claiborne
Charles M. Cohn
Charles H. Dickey
Edmund S. Dickey
Howell Fisher
R. C. Frampton

MARYLAND—*Continued*

Baltimore

H. B. Lohmeyer
E. Bartlett Hayward
Wm. J. McGurty
G. P. Marrow
W. R. Moulton (I)
E. S. Newbold
L. Irving Pollitt
Edward L. Rieha (M)
H. M. Riley (D)
Albert Rosenthal (D, M)
R. S. Scott
Carl C. Thomas (D)
Fred H. Wagner

Hagerstown

F. J. Bullard
R. C. Saylor

Lonaconing

L. N. Rancke

Sparrows Point

L. B. Robertson (M)

MASSACHUSETTS

Athol

Hiram Helman

Attleboro

William J. Luther

Beverly

C. R. Prichard (M)

Boston

C. A. Alden
Perry Barker (C)
W. B. Calkins
Herbert N. Cheney
J. C. D. Clark (M)
F. N. Eisenman
John A. Gould (D)
Robert Grant
Chas. W. Hunter (M)
D. C. Jackson
Wm. J. Lavelle (D)
A. D. Little
W. E. McKay (M)
Norton McKean
D. E. Manson
Arthur E. Norton (D)
Harry A. Norton
Edward Page
A. R. Patterson (A)
Theo. H. Piser
J. L. Richards
F. P. Royce
Howard T. Sands
Albert B. Tenney
Bowen Tufts
Hans von Vittinghoff (C, M)
P. B. Webber
F. K. Wells
M. E. Wilbur
L. J. Willien, Jr.
William A. Wood (M)
E. N. Wrightington

Brockton

G. H. Priest
W. G. von Gemmingen-Hornberg

Cambridge

Albert M. Barnes (D)

Charlestown

Samuel J. Fowler (A, C, D, I, M)

Dorchester

F. A. Wood

East Boston

N. W. Gifford

East Braintree

Geo. P. Smith, Jr. (D)

East Cambridge

Isaac T. Haddock
J. P. Kennedy

MASSACHUSETTS—*Continued*

Everett
Robert M. Folsom
J. M. McClellon
H. L. R. Nickerson
C. A. Raymond
A. B. Way
John F. Wing (M)

Fall River
John R. Baker
R. B. Clark (M)
E. R. Hamilton (C)
Joseph E. Nute (M)

Fitchburg
Clifton R. Hayes
George W. Stiles (M)

Haverhill
Charles Otten, Jr. (M)
F. M. Roberts (M)

Holyoke
O. W. Adams (M)

Lawrence
C. J. R. Humphreys (M)
R. G. Humphreys (M)
W. M. McQueston (M)
Fred H. Sargent
H. G. Taylor (M)

Lowell
W. B. Osborne

Lynn
F. E. Drake (M)
H. K. Morrison (M)

Malden
C. E. Paige

New Bedford
Robert Lindsay
Wm. H. Snow (M)

Newton
Waldo A. Learned

North Woburn
J. E. Philbrick

Pittsfield
Harry C. Crafts (M)

Quincy
Wm. B. Nichols (D)

Roxbury
F. F. Tripp (I)

Salem
J. L. Tudbury

Springfield
Benjamin P. Bill
Wallace H. Bradley
Herman Burgi (M)
Charles H. Tenney

Webster
H. S. Shaw

Weymouth
R. R. Gardner

Winchester
Chas. W. Hinman (C)

Worcester
Dana D. Barnum (M)

MICHIGAN

Adrian
F. E. Park

Ann Arbor
Henry W. Douglas (M)
Alfred H. White (C)

Battle Creek
F. K. Berry
D. H. Frazer

Bay City
Samuel Ball (M)

Benton Harbour
Edward Olsen (M)

MICHIGAN—*Continued*

Detroit

A. T. Baldwin
W. T. Barbour
J. W. Batten
C. W. Bennett (D)
D. L. Brush, Jr.
Warren S. Blauvelt (M)
D. F. Burritt
V. F. Dewey
H. M. Eaton
R. A. Field (D)
A. J. Fischer
Wm. G. Henry (M)
H. W. Hunt
Ralph A. Jayne
E. H. Jewett
George I. Keal (M)
Nathan G. Leakey (M)
T. J. Litle, Jr.
James T. Lynn
George Osius (C)
Charles S. Ritter
Henry D. Schall (D)
C. A. Schwarm (D)
Otis A. Sinsel (M)
A. I. Snyder
F. W. Steere (C)
C. H. Stone
B. O. Tippy
A. A. Treadway (D)
R. Van Vliet
A. L. Wilkinson
L. E. Worthing (C)
L. B. Young (M)

Grand Rapids

Jos. H. Brewer
G. R. Chamberlain
S. W. Cheney
John Hellen
Frank T. Hulswit (A)
Jno. A. Hulswit (A)
Chas. B. Kelsey
Richard Schaddelee
A. G. Schroeder (A)
F. W. Seymour (M)
T. J. Weber
John T. Young

Jackson

Jas. A. Brown
W. M. Eaton
B. R. Laraway
C. W. Tippy

Kalamazoo

Frank W. Blowers
Charles T. Chisholm
T. E. Grant
J. J. Knight (D)
F. A. Lemke

Lansing

L. B. Rogers

Marquette

H. J. Waterbury (D)

Marshall

Carroll Collins (M)

Menominee

Albert R. White

Port Huron

J. C. Sloan

Sault Ste Marie

James Trimble (C)

Watervliet

C. C. Schiller

MINNESOTA

Duluth

C. W. Andrews
David Elder
David A. Reed

Faribault

B. W. Cowperthwait

Mankato

Robert E. Brown

Minneapolis

A. E. Call
F. C. Shepard (M)

MINNESOTA—*Continued*

St. Cloud

H. G. Williams

St. Paul

A. H. Anderson
John P. Crowley (A)
Paul Doty (A)
D. W. Flowers (M)
Ole S. Johnson (D)
Morton Lake (D)
E. L. Lambert (D)
W. H. Nelson (M)
Bert. F. Pelton (D)
George Steinwedell

Winona

Wm. F. Clausen

MISSISSIPPI

Hattiesburg

H. F. Wheeler

Meridian

A. B. Paterson

Vicksburg

John J. Gannon (D)

MISSOURI

Boonville

W. E. Sombart

Chillicothe

C. M. Willis (M)

Excelsior Springs

Saml. W. Henderson

Independence

Robert S. Miller (M)

Joplin

B. J. Crahan

Kansas City

E. L. Brundrett
E. W. Hammond
A. Hurlburt (D)
E. E. Keeler
F. F. Schauer (D)
John M. Scott (A)

St. Charles

Lee G. Stealey

St. Joseph

V. L. Elbert (M)
Wylie Mitchell

St. Louis

Vernon Baker
T. R. Beebe
J. F. Bulfin
J. J. Burns (I)
G. H. Curry
J. M. Curtin
John Dell (M)
G. D. Dodd
Edwin Dowley
A. C. Einstein
Geo. B. Evans (C, M)
R. D. Hatton
C. L. Holman
Albert Knabe
S. A. Laudlaw
W. A. Lockwood
E. P. Lynch
James McElevey
J. E. McLeod
Wm. J. Murphy
Edw. S. Murray
C. J. Nicholls
H. O. Nies
G. W. Parker
H. H. Pipkin
Jesse E. Pipkin
Barney H. Sanders (M)
Robert Seeger
C. H. Stewart
W. H. Thomson, Jr.
Jacob D. von Maur
H. C. Wehnert (M)
W. H. Whitton
Leigh Wickham
J. A. Williams

MISSOURI—*Continued*

Webster Groves

J. E. Hillemeyer (D)
S. H. Wallace

MONTANA

Billings

R. C. Cardell
Ira C. Covert (M)

NEBRASKA

Beatrice

Thomas Rice

Fairbury

B. G. Dawson

Hastings

A. W. Borden

Lincoln

G. A. Montgomery

Omaha

G. W. Clabaugh
H. O. Dummett
Alfred H. Hansen
G. M. Johnson
D. H. Levan
Joseph Lucena (D)
J. H. Malin
A. M. Sommar (A)
Wm. H. Taylor (M)

NEW HAMPSHIRE

Concord

A. J. Smith (M)

Keene

G. M. Rossman

Manchester

Walter G. Africa (M)
Alex. H. Scott (M)

Nashua

Walter F. Norton (M)

NEW JERSEY

Atlantic City

Carlton Geist

Atlantic Highlands

R. H. Garrison

Bayonne

K. G. Mackenzie (M)

Belmar

Joseph Mayer

Bridgeton

J. B. Jones (M)

Burlington

Edward Hering (M)

Camden

John J. Burleigh
C. G. Cook
George W. Curtis
James N. Downey
Harry Ellis (D)
George Hobdell
E. F. Miller
E. A. Moore
J. A. Riggins
Wm. J. Rodgers (D)

East Orange

J. S. String (M)

Elizabeth

Roger Crilley (M)
Francis Engel (D)
G. C. Tenney (D)

Glassboro

Charles W. Hoy

Gloucester City

F. G. Corbus
F. N. Hamerstrom (I)
Alphonso Mason
Sidney Mason
Wm. P. McCoy
R. ff. Pierce
Townsend Stites
C. W. Wardell (M)

NEW JERSEY—*Continued*

Hackensack

J. N. Killgore
Emory D. Minard (D)
E. C. Roberts (A)
W. N. Tolman (M)

Hoboken

John Cabot
Albert F. Ganz
L. J. Platt (D)
C. R. Schroeder

Jersey City

James Ashworth
West Bissell
W. H. Caldwell
David R. Daly
E. J. Donahue (D)
J. P. Henofer
Donald Mac Arthur
J. B. Redd
F. W. Schmidt
C. W. Smythe

Long Branch

F. R. M. Cutcheon (M)
L. E. DeQuine (D)

Morristown

Conrad Schuck, Jr. (D)

Newark

Edward B. Annett (D)
William S. Barker (A)
H. W. Battin
Theodore Bunker
John A. Clark, Jr.
J. S. De Hart
E. H. Earnshaw (M)
H. H. Ferris (M)
A. J. Ford
Ellsworth Francisco (D)
W. M. Halsey (A)
J. P. Hanlan
F. A. Lydecker (D)
Thomas N. McCarter
J. G. O'Keeffe
W. H. Pettes (A)
John P. Petty (A)
O. F. Potter (A)
Otto Reiner
Geo. J. Roberts
J. McClellan Rogers (D, M)
Jas. R. Schurz
Alexander H. Strecker
Robert K. Wehner
H. D. Whitcomb (M)
Percy S. Young
R. R. Young (A, D, I)

New Brunswick

J. C. Roberson
S. K. Zook

Ocean City

A. H. Osborn
Martin Maloney, 2d (D)

Passaic

Oliver H. Folger (D)

Paterson

John Bimson, Jr.
Jas. M. Lane
C. J. Roeser (D)
W. H. Rogers (A, D, I)

Perth Amboy

Geo. A. Balz
H. Foersterling (C)
A. F. Reitemeyer (M)
Louis A. Witte

Plainfield

W. R. Causebrook (A)
Thomas L. Mellick (D)
F. M. Smith
W. F. Terradell

Princeton

John F. Hoff (D)

Rahway

Daniel Miller

Somerville

A. P. Beardsley

NEW JERSEY—*Continued*

South Amboy

A. L. Way

Summit

J. W. Hornsey
M. S. Sherwood

Trenton

James H. Galt (M)
Frank D. Moses

NEW YORK

Albany

F. S. Dunn (M)
Wm. G. Furlong
John J. Garrison
E. P. Gavit (A)
C. H. Graf (M)
Frederick J. Ikena (M)
C. F. Leonard
Donald McDonald
F. McDonald (M)
William McDonald
R. E. Sard
F. A. Schobel

Amsterdam

G. D. Conlee (I)
W. H. Cooper (M)

Astoria, L. I.

F. J. Cotton (M)
W. J. Hawthorne
H. H. Himsworth (M)
H. L. Jochum
W. F. Lawrence (M)
M. E. Mueller (M)
John C. Shaw
N. J. Sperling (M)
Crist H. Stevick (M)
A. H. Zane

Brooklyn

T. M. Ambler (I)
E. J. Bartel
Fred. S. Benson, Jr. (M)
Charles Boone
John H. Braine (M)
Robert W. Bush (M)
Edward J. Byrne
Edward Louis Byrne
T. E. Byrne
G. S. Callaway (M)
C. E. Cheeseman (M)
W. VanAlan Clark (M)
Francis Colton
J. H. Cozzens (D)
Charles A. Cross (M)
Guy K. Dustin
Charles M. Ford
R. L. Greene (M)
G. S. Hendrickson (M)
A. B. Hohman (M)
W. A. Jack (M)
Edwin D. Jones
E. R. Jourdan
J. H. Jourdan (M)
R. C. Kellogg (D)
W. W. Kunze (M)
J. P. Leask (M)
R. C. Lewis
Henry E. McGowan
R. MacSaveny, Jr.
E. H. Marsh (D)
E. H. Mathews (M)
A. J. Mendez
Samuel A. Mills (M)
Albert F. Murphy
E. J. Murphy (C)
H. B. Reading (M)
A. H. Schaaf (M)
S. V. Seddon (M)
Milton See, Jr.
S. W. Slater (D)
A. F. Staniford
R. H. Staniford

NEW YORK—*Continued*

L. S. Stiles (M)
R. H. Strader (M)
E. C. Uhlig (C)
A. J. Voorhees (M)
W. M. Wepfer (M)
John T. White (D)
S. T. Willson
P. B. Wiske
H. A. Wuest

Buffalo

Lucius S. Bigelow (D)
J. E. Burke (D)
H. C. Palmer (M)
William S. Riselay (A, D, I)

Canandaigua

V. A. Miller

Coney Island

Harry J. Dillon
Geo. H. Woodall

Far Rockaway

Edw. L. Davies
L. A. Howland
Carlton Macy (M)
J. C. Sheehy

Flushing

Martin Morrison
M. H. Spear (M)
Edw. J. Sullivan
W. H. Sullivan

Geneva

E. H. Palmer

Glens Falls

H. M. Collin
Henry Rochat

Gloversville

Louis C. Smith

Hempstead

C. F. Callahan
O. J. A. Lundblad (M)

Ithaca

James W. Murdock

Kingston

R. F. Chidsey
C. R. Stull
Franklin Tobey, Jr.

Lockport

J. A. Noble

Long Island City

Clifford S. Fox
Harry L. Snyder (A)
C. G. M. Thomas (A)

Macedon

R. M. Parker

Mt. Vernon

G. E. Bennitt
Chas. F. Bryant (A)
W. J. Clark
Sidney S. Coles
J. W. Green
R. J. Jennings
Alfred M. Keene (A)
R. M. Kellogg (M)
Paul Kruger
G. T. Macbeth (D)
W. L. Secord (D)
S. G. Tarrant (A)
Stuart Wilder.

Newburgh

A. R. Beal (I)
G. H. Smith (D)
F. W. Vredenburgh

New York City

H. C. Abell
Walter R. Addicks
A. B. Allen (M)
H. E. Almberg
H. W. Alrich (M)
J. Charles Andrews

NEW YORK—*Continued*

New York City

J. H. N. Armstrong (A)
C. G. Atwater (C)
C. T. Ayres
A. C. M. Azoy
T. S. Barlow (M)
W. W. Barnes (I)
F. H. Barnitz (A, D, I)
William E. Barrett
Wm. F. Barrett (M)
W. H. Barthold
F. Behrend
E. W. Bell
W. C. Besson (D)
Francis Blossom
William H. Bradley
James C. Brady
Ernest C. Brown
H. M. Brundage (A)
M. F. Buckley
J. H. Budde (M)
D. M. Bull
S. H. Bunnell (M)
Thos. J. Byrne (M)
Elbert P. Callender
S. K. Campbell (D)
C. M. Carbonell (D)
Frank Carpenter
Harold Carpenter
Robert A. Carter
Robert A. Carter, Jr. (M)
Dr. Chas. F. Chandler
C. H. B. Chapin
E. S. Chapin
F. P. Cheesman
S. R. Church (C)
B. C. Cobb
James P. Conroy (I)
Horace G. Cooke (M)
Marshall Cornine
George B. Cortelyou
William M. Crane (M)
Philip Cross
H. R. Crowell
J. L. de Castro (M)
William DeFreitas
F. R. DeVoe
R. L. Dezendorf
J. Alfred Dixon
R. M. Dixon
George W. Doane
Henry L. Doherty
Chas. Dougherty (D)
Philip Dunne (D)
W. K. Eavenson
Arthur H. Elliott (C)
Charles B. Elmer
J. R. Fenniman (A)
Wm. M. Flook
O. H. Fogg
Alfred E. Forstall (M)
C. G. Francklyn (M)
Gilbert Francklyn
Frank W. Frueauff
Lewis B. Gawtry
C. J. Gefvert
Patrick Goodman
W. R. Goudy (A)
M. M. Graham
Orange G. Griffin (D)
D. M. Griffith
C. A. A. Griffiths
Norman J. Griffiths (A)
R. G. Griswold
F. E. Haag (A)
Theodore Haight (C, M)
A. H. Hall (D)
J. M. Haralson
Joseph B. Hare (D)
W. K. Harrington
Harold A. Hayward (D)
Sterling F. Hayward
F. D. Herbert
C. M. Higgins
Willard F. Hine (A)
Chas. H. Hodges (M)
A. S. Hoffman

NEW YORK—*Continued*

New York City

Frederic deP. Hone (M)
David L. Hough
Abram C. Howard
W. G. Hoyt
D. S. Hudson (M)
A. C. Humphreys (A)
F. W. Humphreys (D, M)
Jas. F. Hunter (M)
Edward B. Hyde (A, D, I)
H. B. Hyland
Charles W. Isbell
C. N. Jelliffe (D)
Adolph C. Johnson
Mervyn E. Johnston (A)
C. F. Keegan (M)
Wm. D. Kelley
James S. Kennedy (M)
I. Clayton Kingsbury
M. Kirchberger (I)
Wm. J. Knapp
George Lange (A)
A. P. Lathrop
Albert Lauber (I)
James Lawrence (A)
Robert E. Livingston
Edward G. Love
Charles E. Lucke
Robert O. Luqueer (M)
William McClellan (M)
Isaac McGraw (M)
W. N. McIlravy
H. B. McLean
Emerson McMillin
Marion McMillin
Norman Macbeth
George MacDonald
W. L. MacIntosh (M)
A. Fred Macklin (M)
D. T. MacLeod
J. I. Mange
J. H. Mansfield
F. C. Martineau (D)
John A. Mason
J. Alex. Mayers
Giles W. Mead
E. C. Miles
Preston S. Millar (I)
Alten S. Miller (M)
Robert C. Miller
W. Cullen Morris (M)
William G. Morris (A)
E. A. Nelson (D)
F. H. Nickerson
Edwin North
John O'Connell (M)
M. Webb Offutt (M)
Alva L. Palmer (D)
Harry M. Papworth
G. W. Parkhurst (A)
A. Parshall
H. L. Peden
Irwin W. Peffly
J. H. Perkins (A)
D. J. Prendergast (I)
Charles Raabe (M)
Geo. G. Ramsdell
W. W. Randolph
Wm. T. Rasch (D)
P. F. Reichhelm
Hugo B. Reinach (A)
James F. Reynolds
Daniel Riordan
Arthur R. Ritchie (M)
Chas. D. Robison (M)
Wm. A. Root
Robert R. Rust
Eugene Y. Sayer (M)
E. H. Schmidt (D)
P. J. Schneider (A)
Thomas Scofield (I)
Thomas Shaughnessy, Jr.
Richard Shepard
Marvin Shiebler
C. C. Simpson (D)
Henry Simpson
C. G. Smith (A)

NEW YORK—*Continued*

New York City

E. L. Spencer
R. E. Sperry
Arthur W. Stark (M)
C. N. Stevens (C)
John Stilwell
W. B. Taber, Jr.
F. M. Tait
G. W. LeR. Travis (D)
Lucien P. F. Tull (A)
A. E. Turner (D)
H. L. Underhill (M)
W. H. Van Winkle (D)
George H. Warner
F. C. Weber (M)
T. G. Weber (M)
L. H. Werner (A)
Benjamin Whiteley
Louis Wilputte
R. M. Wilson (D)
S. E. Wolff (D)
George E. Woods
Edwin S. Young (D)

Niagara Falls

Albert H. Merritt

Nyack

E. C. Peebles (M)

Ossining

O. G. Bennett (A)
H. W. Terry, Jr. (D)

Oswego

R. F. Whitney (M)

Owego

A. P. Storrs (I)
Chas. P. Storrs (I)

Plattsburg

George M. Cole

Portchester

J. K. Crowell (D)
Joseph P. Kane (D)

Port Washington

John E. Bullard (I)

Poughkeepsie

T. R. Beal (D, M)
Hugh M. Beugler (D)
L. H. Scherck (I)
Charles Waldron, Jr. (M)
A. R. Wellwood

Rochester

J. C. Collins
James B. Eaton
J. P. Haftenkamp (M)
Frank Hellen
James T. Hutchings
I. Lundgaard (M)
J. P. MacSweeney
F. H. Patterson
Herman Russell
E. C. Scobell (A)
Robert M. Searle (M)
C. A. Tucker (A)

Rome

H. W. Mitchell
A. B. Morton (M)

Rosebank

William McCleary

Sag Harbor

R. C. Graveley

Saranac Lake

Charles A. Gruber (D)

Saratoga Springs

Patrick F. Roohan (M)

Schenectady

Henry W. Peck (A)
V. vonStarzenski (M)
M. G. Welsh (M)

Stapleton

John J. Callahan (D)
W. M. R. Hammond (A)
H. Muller, Jr. (D)
W. J. Welsh (M)

NEW YORK—*Continued*

Syracuse

William H. Blauvelt (M)
Joseph Butler
C. M. Cole
James C. DeLong (I)
S. J. Dickey (M)
A. D. Dudley
E. W. Poole (A)
Bates Torrey, Jr.
S. C. Singer (D)
G. I. Vincent
L. M. Whitwell (M)
Edwin C. Witherby (M)

Tarrytown

Ernest R. Conover (A)
John A. Neth

Tonawanda

C. W. Wallace

Troy

James H. Caldwell
W. C. Coleman
Henry C. Shields (M)

Utica

W. J. Cahill (D)
H. G. Johnson (M)
Wm. E. Lewis

Watertown

Fred A. Rogers (A)
John B. Taylor
Peter Young

Westchester

John D. Alden
J. M. Butler
E. H. Rosenquest

West Point

I. N. Goff, Jr.

White Plains

John Malakoff
E. S. Martin

Yonkers

E. O. Baxter
J. E. Galligan
H. B. Kellogg
A. M. Knapp
Herbert Sherwood (D)
Charles F. Timm
Wm. G. Wright

NORTH CAROLINA

Asheville

J. D. Caldwell (M)
H. W. Plummer

Charlotte

T. B. Whitted

Greensboro

C. H. Andrews

Raleigh

S. P. Cobb (M)

Rocky Mount

J. B. Cocke (M)

OHIO

Ashtabula

F. W. Stone

Chillicothe

F. A. Stacey

Cincinnati

W. S. Guitteau (D, M)
William A. Miller
Andrew J. Stacey
James E. Stacey

Cleveland

John Drewson
C. S. Eaton
H. C. Fritz
F. R. Hutchinson (D)
Edward P. Hyde (I)
W. H. Knight (M)

OHIO—*Continued*

Cleveland
Karl Nibecker (M)
Melvin Pattison (M)
A. T. Perry (C)
C. H. Printz
W. E. Steinwedell
Frank E. Taplin

Columbus
Thomas J. Jones
S. S. Wyer

Dayton
R. H. Lawlor
Edward H. Light (D)
George Light
W. W. Price

Delaware
Thomas C. Jones

Hamilton
Lazard Kahn

Mansfield
William C. Hedges (M)

Marion
George Whysall

Middletown
G. F. Ahlbrandt (M)

Steubenville
E. H. Collester (M)

Washington Court House
H. E. Estberg

Youngstown
Fred S. Coombs (M)
Caleb Davies, Jr. (M)
W. E. Manning
G. A. Reinhardt

OKLAHOMA

Bartlesville
W. H. Merritt

McAlester
F. A. Willard

OREGON

Portland
S. C. Bratton
Elmon L. Hall (C, D, M)
Hilmar M. Papst

PENNSYLVANIA

Allentown
J. Ward Crankshaw
John A. Frick
A. C. Taylor (M)
C. P. Warner

Ardmore
Howard Hoffman (M)
Isaac N. Knapp (M)
John L. Mather

Bangor
D. M. Hambright

Berwick
L. D. Spragle (M)

Bethlehem
W. F. Brodnax
R. C. Morris, Jr.

Bolivar
N. A. Young (M)

Bradford
George P. Boothe
Fred A. Miller (M)

Carbondale
Chas. L. Rowland
A. B. Scherr

Carlisle
C. Faller

Catasauqua
G. W. Steele

Chambersburg
M. K. Burgner

PENNSYLVANIA—*Continued*

Chester
Hugh C. Aiken
F. A. Bond
L. D. Huestis (M)
J. J. Morrissey
Geo. W. Savage
J. D. Shattuck
G. W. Thomson (I)
Wm. M. White
Charles Wilde (D)

Clearfield
Warren Partridge (D)

Coatesville
A. P. McCarthy

Collingdale
Thomas B. Tinney

Colmar
R. H. Dutton

Crafton
T. J. Smith, Jr.

Dallastown
C. C. Grimm

Danville
J. Vander Bout

Darby
Charles J. Fox

Easton
Frederick Baty
H. M. Beck
B. F. Cresson
R. J. Halloran
Edwin G. Holzer
Wm. D. Ray

Erie
F. H. Payne

Hamburg
A. J. Althouse

Hanover
E. E. Bair

Harrisburg
W. D. Baldwin
C. M. Kaltwasser
L. S. Williams

Irwin
Edwards F. Wilson

Jenkintown
L. R. Dutton (D)

Johnstown
John E. Morgan

Kennett Square
R. E. Dallas (A)
G. J. Maloney

Kingston
J. H. Gaylord
A. J. Llewellyn

Lancaster
B. H. Spangenberg (D)
H. J. von Nieda

Lebanon
Geo. S. Speaker

Lewistown
Frank P. Duggan

McKeesport
C. E. Underwood

Mauch Chunk
Eugene Causbrook

Mount Carmel
Frank B. Fisler

Norristown
H. B. Bryans (M)
H. H. Ganser (I)

Oakmont
F. W. Sperr, Jr. (C)

Philadelphia
H. C. Adams
E. R. Alburger (M)
Walter A. Allison (M)
H. B. Andersen (D)
James Ball
Henry S. Battin (D)
Wm. P. Baylie (A)
Albert B. Beadle (M)

PENNSYLVANIA—*Continued*

Philadelphia

R. H. Beaumont (M)
W. W. Beaumont
Samuel T. Bodine (D)
Charles O. Bond (I)
Cyrus Borgner (M)
Albert M. Boyd (D)
C. A. Braun
Wm. L. Brown
Charles L. Bruff (M)
Ervin Calhoun (A)
F. A. Canon
E. G. Carlisle
H. R. Cartwright (M)
Andrew J. Carty
W. A. Castor (D)
W. L. Chewning
W. A. Clader (A)
Charles J. Clark
Walton Clark
David J. Collins
Roger B. Combs
H. R. Cook, Jr. (M)
R. C. Cornish
J. A. P. Crisfield
W. T. Crouse (A)
G. W. Curran (A)
S. P. Curtis
P. T. Dashiell (M)
H. W. Davies
C. H. Diffenderffer
W. F. Dorner (D, M)
J. B. Douglas (D, M)
W. F. Douthirt
R. B. Duncan (D)
W. G. Earnshaw
L. B. Eichengreen (M)
Owen B. Evans (M)
S. E. Fairchild, Jr. (M)
Walton Forstall (D)
J. Scott Fowler (D)
F. C. Freeman
W. H. Fulweiler
W. H. Gartley
Clarence H. Geist
Thomas S. Genay (A)
Francis H. Gilpin (I)
H. W. Graeff
T. J. Grayson
Albert Green
John Gribbel
W. Griffin Gribbel (D)
R. E. Griffis (D)
H. O. Gross
Clifford L. Haldeman
Charles F. Hardick (A)
C. Willing Hare
William E. Helme (D)
G. R. Hemminger (A)
H. E. Hodgson
J. H. Hubbs
Herbert E. Ives
Thos. H. Jackson (A)
Robert C. James
C. C. Jones
Edwin P. Jones
A. C. Klein (M)
J. B. Klumpp (M)
P. J. Lafore
W. P. Lane
L. R. Lemoine
J. C. Lightfoot
Lewis Lillie
J. D. McIlhenny
Andrew P. Maloney (M)
W. H. Marshall (A)
P. C. Mayfield (M)
James B. Mingus
F. N. Morton (M)
Wayne R. Moyer
H. P. Murphy (M)
Edw. B. Myers
Joseph B. Myers
H. H. Nevanas (M)
Carroll B. Nichols
Rollin Norris
C. J. O'Donnell

PENNSYLVANIA—*Continued*

Philadelphia

W. H. Parish
Joseph S. Parker
J. A. Pearson
Harry G. Peck
H. P. Penfield (M)
M. F. Perkins (M)
Rowan P. Perkins (M)
Jos. A. Perry (M)
H. W. Plucker
Edward Porter (A)
A. P. Post
John V. Postles
C. V. Roberts (D)
Edward H. Rodgers
Robert J. Rolston
W. L. Rowland (C)
J. M. Ruegenberg
John M. Rusby (M)
James Russell
N. F. S. Russell
F. J. Rutledge
W. F. H. Schultz (M)
H. S. Schutt
Harold K. Seeley (D)
W. J. Serrill (D)
A. E. Shaw
H. R. Sheppard
C. S. Smith
G. L. Smith
J. H. Smith (A)
C. S. Snyder (D)
F. B. Stem
J. W. Stirzel
J. W. Stirzel, Jr.
L. J. Strause
M. W. Stroud
W. B. Taber, Jr. (M)
J. H. Taussig (M)
P. D. Taylor (M)
N. W. Thomas (C)
Paul Thompson
F. G. Thorn, Jr.
C. C. Tutwiler (C)
S. P. Vecker
H. B. Vincent
E. P. Walter (D)
Chas. P. Warner (D)
J. H. Warnick
C. H. Weak
John S. Welch
D. B. Wentz (M)
F. V. Westermaier (I)
Henry Wharton
Walter Whetstone
Robert H. Whipple
Edward R. Wood, Jr. (M)
Wm. M. Wood (D)

Phoenixville

T. E. Spence

Pittsburgh

Arthur Booth
Alfred P. Brill
Albert G. Davis (C)
Charles D. Evans
Otto F. Felix (M)
J. E. Gill
A. W. Grant, Jr. (M)
Joseph F. Guffey
R. L. Hibbard
Henry Koppers
Edw. D. Leland
T. L. Lewis
Herman Livingston
W. L. McCloy
J. C. McDowell
Wm. McKee (M)
C. S. Mitchell (A)
John J. Murray
G. R. Nutty
H. C. Porter
C. J. Ramsburg (M)
James H. Reed, Jr.
Joseph A. Reed
Edwin Ruud
T. V. Salt
W. F. Schell (D)

PENNSYLVANIA—*Continued*

Pittsburgh
Kenneth Seaver
A. E. Smyser
Frank N. Speller
S. B. Stewart
Wm. W. Weller
R. W. H. Young
R. H. Youngman

Pittston
Albert Morris

Pottsville
J. McKnight

Reading
George B. Bains, 3d
J. W. Galloway
C. L. Hoffman
John H. Keppelman
E. G. Russell

Scranton
Worthington Scranton
Harold N. Squier (M)
E. M. Stack (A, D, I)

Sewickley
H. A. Carpenter

Shamokin
J. A. Britton

Slatington
Winfield Roper

Smethport
Melville Gillett

Steelton
T. L. Lewars

Sunbury
George W. Beck (D)

Towanda
E. L. Smith

Wayne
N. H. Gellert

West Chester
H. S. Dutton
William O. Lamson, Jr.

Wilkes-Barre
C. A. Wakeman

Williamsport
Ernest H. Davis
G. B. Hodges
Wm. R. Rhoades

Wyncote
N. B. Bertolette (C)
W. S. Fiss

York
O. H. Heckert
Grier Hersh

RHODE ISLAND

Newport
A. K. Quinn

Pawtucket
William McGregor (M)
E. I. Patt
Hans F. Weber

Providence
George E. Allyn
G. S. Barrows (D)
Edmund Cathels (M)
John W. Ellis
C. L. Henderson
T. H. Hintze (M)
Roger W. Polk (M)
C. G. Richardson
R. E. Slade (M)

Slocums
A. B. Slater (M)

Woonsocket
F. J. Nason

SOUTH CAROLINA

Charleston
C. M. Benedict
J. G. Felton
P. H. Gadsden
Edward C. Kollock (M)
G. H. Waring (M)

Columbia
S. W. Brown

Spartanburg
J. A. Callenbach

SOUTH DAKOTA

Aberdeen
Charles A. Howard

Mitchell
E. J. Sherwood (D)

Sioux Falls
A. S. Graham

TENNESSEE

Chattanooga
S. E. DeFrese (D)

Knoxville
Alfred W. Young

Memphis
L. G. Van Ness

Nashville
S. E. Linton, Jr.
B. V. Pfeiffer (M)

TEXAS

Abilene
A. V. Wainwright (D)

Beaumont
A. F. Townsend (D)
M. T. Walker

Dallas
Henry C. Morris

El Paso
K. L. Simons (M)

San Antonio
E. B. Henson
W. B. Tuttle (M)
F. L. Weisser

UTAH

Salt Lake City
Wm. R. Putnam (I)

VERMONT

Barre
L. M. Pease

Brattleboro
H. L. Olds

Burlington
David W. Jardine
Frank H. Parker

VIRGINIA

Alexandria
F. W. Latham

Big Stone Gap
Otis Mouser (M)

Bristol
S. M. Vance

Charlottesville
H. M. Hantzmon

Danville
Frank Talbot (M)

Lynchburg
L. G. Gresham
Ward Wilson

Newport News
W. F. Croston (M)

Norfolk
E. C. Hathaway
R. J. Marks

Petersburg
R. A. Goudy

VIRGINIA—*Continued*

Portsmouth

B. B. Ferguson

Richmond

William P. Knowles

Roanoke

M. M. Milton

Suffolk

Chas. H. Brown

WASHINGTON

Aberdeen

P. A. Bertrand
N. S. Burcombe (M)

Seattle

N. C. Fancher
F. K. Lane
A. F. Mueller

Spokane

R. R. Choate
R. B. Stitzer

Tacoma

W. A. Leuenberger (M)
W. W. Seymour (C)

Wenatchee

Arthur Gunn

WEST VIRGINIA

Bluefield

A. E. Lockwood

Martinsburg

Leon H. Ware

WISCONSIN

Appleton

William Jones

Beloit

Philip S. Dickey (D)
Robert G. Krumrey (D)
B. F. Lyons (M)

Chippewa Falls

Holmes Ives

Eau Claire

A. R. Manley

Fond du Lac

A. G. Carson

Janesville

I. F. Wortendyke

La Crosse

J. W. Moncrieff

Madison

C. A. Comstock
John Corscot
F. L. Cross (A)
Wiley J. Huddle
O. L. Kowalke (C)
W. E. Miller
John St. John

Manitowoc

J. P. Eastman

Milwaukee

M. L. Ardry
Stephen Bialecki
William Billings
John F. Blackie (M)
E. Blonieu
R. B. Brown (M)
Fred Glahn
Sheldon J. Glass
G. F. Gregg
Ewald Haase (A)
W. T. Haertel
Fred Hammett
Henry Harman
Robert Hermann
H. M. Humphrys (M)
R. O. Jasperson
F. A. Jones
W. E. Kemen
Henry Koerts
R. P. Kraft
Albert Kretlow
Adam Kurtz
G. W. Mackie
John T. Mason

WISCONSIN—*Continued*

Milwaukee

David A. Powell
Bruno Rahn (M)
H. L. Rice (A)
H. C. Schaper
Ferdinand Schlesinger
John W. Shaeffer (M)
J. H. Walker
Charles Wiggers
A. C. Wilke (C)
J. C. Wilson (D)

Monroe

H. W. Johonott

Oshkosh

Sinclair Mainland
William Mainland

Platteville

W. C. Butterworth

Ripon

W. E. Haseltine

Sheboygan

H. W. Easterly
R. H. Smith

Wausau

H. H. Wilson (M)

CANADA

Brandon, Manitoba

M. L. Kane

Calgary

A. I. Payne (M)

Chatham

P. S. Coate (D)

Hamilton

P. V. Byrnes
John B. McNary

Montreal

Howard E. Mann (M)
W. F. Pearce

Quebec

R. A. Wallace

St. Catharines

J. J. Humphreys

Toronto

Frederick Burnett
Arthur Hewitt
Daniel L. Hill
C. A. Jefferis
W. H. Pearson

CUBA

Havana

Americo R. Gonzalez
W. E. Mockett

ENGLAND

Grays, Essex

Arthur W. Sumner

Liverpool

William King

London

F. J. Angell
Wm. A. Bone
L. D. Carroll
A. G. Glasgow (M)
A. O. Jones
Frederic Thuman
John T. Westcott
T. A. Vander Willigen

Nuneaton

George Helps

HAWAII

Honolulu

Harry L. Strange (M)

JAPAN

Ichigi, Mikawa

Hideichi Kawai

Kobe

Shosuke Kubo

Nagoya

Sakura Okamoto

Osaka

Kotaro Shimomura

NETHERLANDS
Rotterdam
M. C. Sissingh

NEW ZEALAND
Christchurch
R. C. Bishop

PANAMA
Colon
C. O. S. Howard

PHILIPPINE ISLANDS
Manila
Erich Odrich

PORTO RICO
Rio Piedras
F. S. Pugh

SOUTH AMERICA
Santiago
Juan Blanquier

SWITZERLAND
Minusio
A. E. Boardman (M)

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Connecticut	34	Rhode Island	15
Delaware	2	South Carolina	7
District of Columbia	10	South Dakota	3
Florida	8	Tennessee	5
Georgia	18	Texas	8
Idaho	2	Utah	1
Illinois	139	Vermont	4
Indiana	38	Virginia	15
Iowa	28	Washington	10
Kansas	10	West Virginia	2
Kentucky	6	Wisconsin	59
Louisiana	3	Canada	14
Maine	9	Cuba	2
Maryland	26	England	11
Massachusetts	84	Hawaii Territory	1
Michigan	68	Japan	4
Minnesota	19	Netherlands	1
Mississippi	3	New Zealand	1
Missouri	51	Panama	1
Montana	2	Philippine Islands	1
Nebraska	13	Porto Rico	1
New Hampshire	5	South America	1
New Jersey	102	Switzerland	1
New York	400		
North Carolina	6	Total	1,635

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